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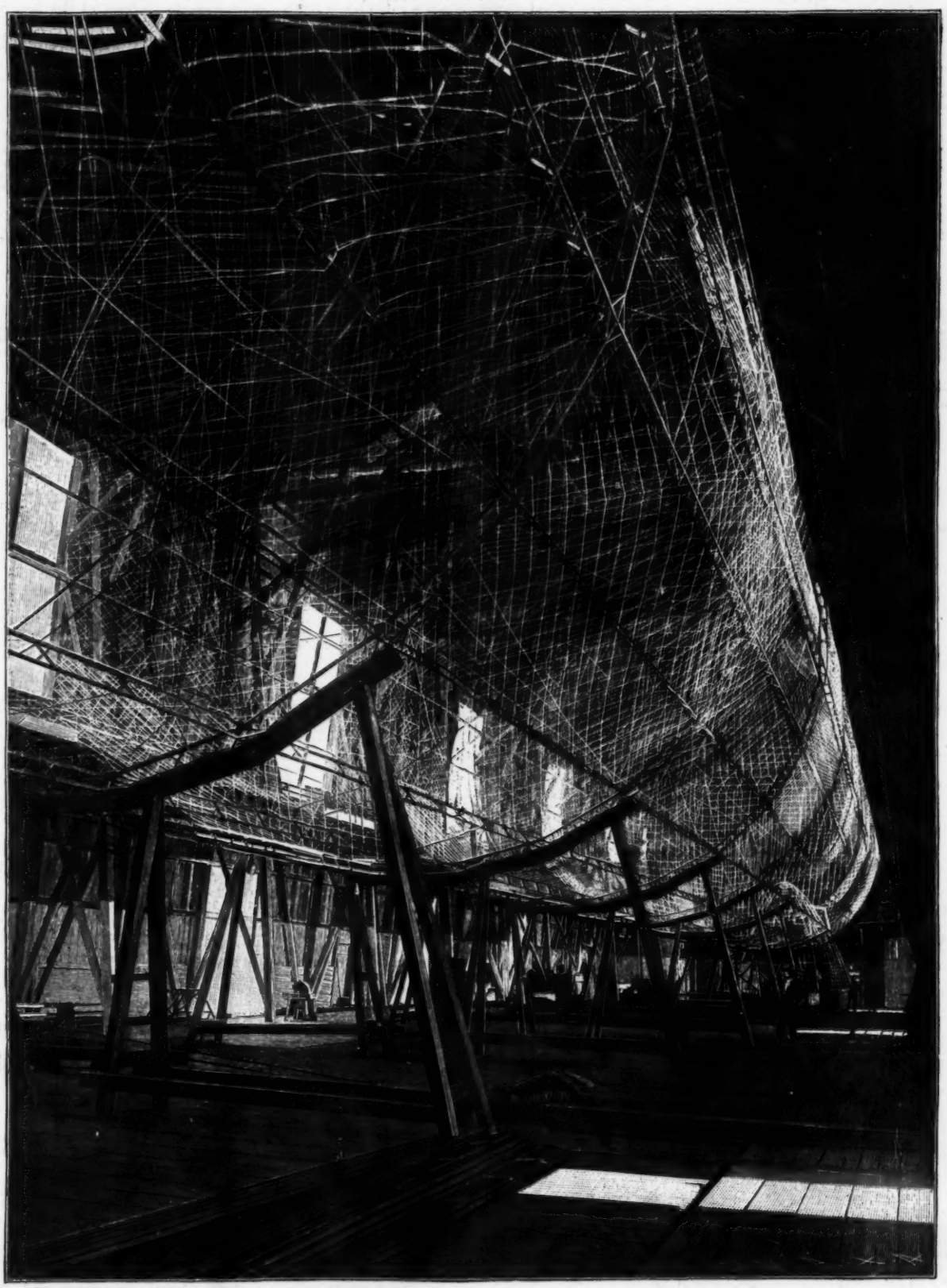


COUNT VON ZEPPELIN'S AIRSHIP IN COURSE OF CONSTRUCTION.

COUNT VON ZEPPELIN'S DIRIGIBLE AIRSHIP.

Much has been written of the huge airship which Count von Zeppelin is building on a float anchored in the Lake of Constance; but hitherto no trustworthy description of its structure has been published. The inventor has at last overcome his reticence and has given to Ueber Land und Meer enough information to enable us to form some conception of his contrivance.

The new airship is housed in a floating structure 500 feet in length, 80 feet in width, and 70 feet in height anchored in the Lake of Constance. Each side of the housing is pierced with eleven large windows which admit sufficient light to the interior. In order to offer as little resistance to the air as possible, the housing and the float on which it is built have been tapered at the front or bow. Offices and storerooms are provided in the bow together with sleeping accommodations for the night-watch. A passage-way more than 3 feet wide runs around the entire structure and widens out into a platform at the bow. The housing is built upon 95 pontoons and consists of an outer and inner part. The outer part comprises the walls and roof and is held together under water by a strong framework. The inner part rests upon separate pontoons and is entirely independent of the outer part; it is so constructed that together with the air-ship it can be towed out of the housing and back again. In the interior, at one side, a staircase has been built which leads to the roof and ends in a passage-way beneath the ridge-pole. The passage-way extends the entire length of the structure, and by its means the workmen are enabled to reach the ship from above.

The question naturally arises: Why was the housing built on water and not on land? It is evident that the first voyages of the ship will, of necessity, be in the nature of experiments, and should therefore be made under the most favorable conditions. A large area without any obstruction is therefore absolutely necessary. Such an open space is found only upon a large sheet of water; and for this reason Count von Zeppelin decided to build his air-ship upon the Lake of Constance. Moreover, the housing being anchored only at one end, shifts its position as the wind changes, so that its longitudinal axis is in line with the direction of the wind. Under these conditions the ship can ascend without colliding with the sides of the housing.

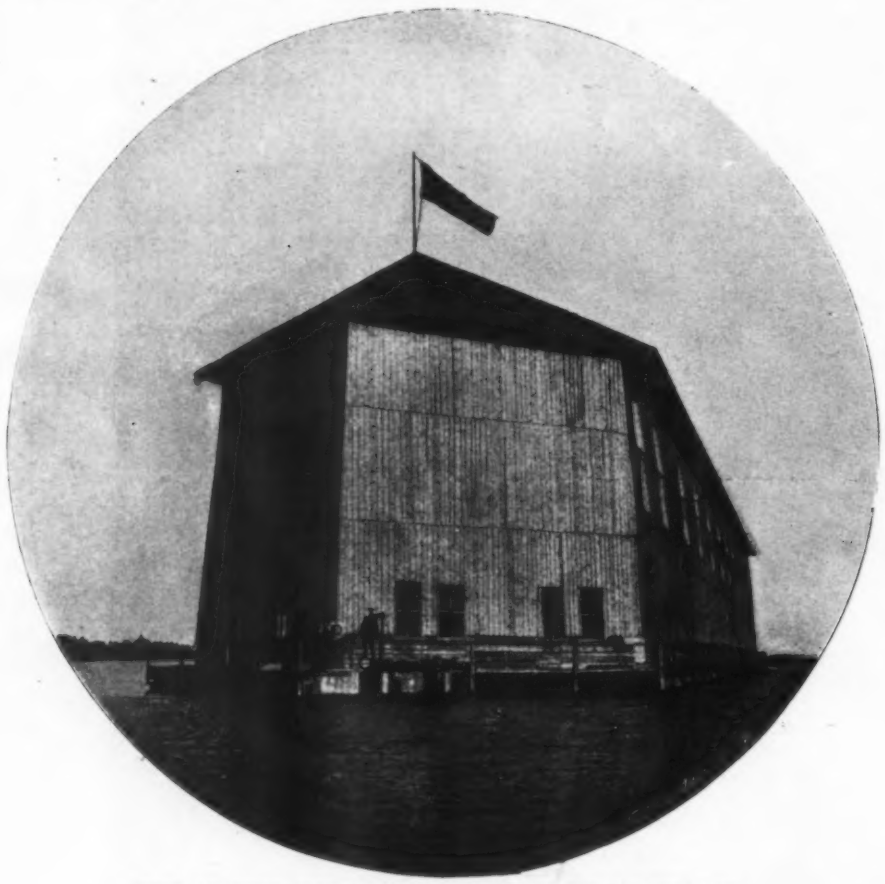
A structure so enormous in size naturally offers no little resistance to the wind. The Lake of Constance is often swept by violent storms. Several times the housing broke loose from its moorings; but precautions have now been taken which will prevent a recurrence of the accident. The float has been anchored to a block of cement 4½ tons in weight, sunk at a depth of 72 feet, and held in place by steel hawsers 250 feet long, secured to two ship's anchors weighing over 5,000 pounds each. If despite these precautionary measures the housing should again break loose, two heavy anchors at the bow of the float can be lowered to prevent the float from being driven ashore.

The airship now in the course of erection within this structure is 410 feet long. The supporting body is a cylinder 39 feet in diameter, the ends being tapered so as to offer the least possible resistance to the air. The skeleton frame of this cylinder is composed of aluminium. Sixteen rings separated from one another 26 feet hold the framework together. These rings are not circular, but form a twenty-four-sided polygon; their shape is determined by numerous strong aluminium wires radiating from a central circle like the spokes of a bicycle-wheel. Horizontal bars are used to hold the rings together. The entire framework will be surrounded by a netting of ramie-fiber cord, remarkable for its great toughness and tensile strength. Within the framework and on each side of the rings a similar netting will be disposed.

The sixteen rings divide the cylinder into seventeen compartments, as it were, each of which will contain a balloon or gas-bag. If one of these seventeen independent balloons be injured, the others will remain intact and will still support the airship. The principle evidently resembles that of the watertight compartments of a steamship. But the system is far safer than that employed in vessels, for no connecting doors or openings are used.

The balloons are made of a light, but tough and impenetrable cotton fabric covered with a gas-tight rubber composition. The aluminium framework is still further protected by an outer watertight envelop which serves chiefly to protect the balloons from the direct rays of the sun and from rain. The ramie netting serves the purpose of separating the balloons from one another and from the outer envelop.

The balloons will have a capacity of 351,150 cubic feet and will be filled with hydrogen gas kept under pressure in cast iron cylinders, each of which contains 175 cubic feet. Two thousand cylinders will, therefore, be required. The cylinders will be stored on a float which will be towed to the housing when the balloons are to be inflated. Since a cubic meter (1·308 cubic yards) of gas will raise not more than a kilogramme (2·2 pounds), it follows that the entire weight of the airship including the car, crew, ballast, and motors must not exceed two hundredweight. This maximum weight, however, will not be reached by any means. The load will always be such that should one of the balloons give out the others will always be able to support the airship.



THE AIRSHIP HOUSING IN THE LAKE OF CONSTANCE.

This, in brief, is the general construction of the supporting part of the contrivance.

Every moving body, such as a ship or bicycle, can be steered. That it has hitherto been impossible to direct an airship is due partly to the form adopted in the construction, partly to insufficient motive power, and inadequate steering appliances. Count von Zeppelin claims to have remedied all these faults. He will drive his airship backward or forward by four aluminium propellers, a pair of which will be mounted at each end of the cylindrical body, somewhat below the central axis. The ship will be steered by rudders placed at the front and rear ends.

Rigidly connected with the balloon cylinder are two aluminium cars, each located beneath a pair of propellers. These cars are 21·32 feet long, 5·96 feet wide, 3·28 feet high, and taper from top to bottom. Beneath the bottom of each car are wheels provided with coiled springs which deaden the shock when the airship strikes the ground and set the wheels in motion. In each car is a benzine motor, developing from 12 to 15 indicated horse power, by means of which the propellers are driven. The connection between the propellers and the motors consists of gearing and of driving shafts passing through Mannesmann seamless steel tubes. Variations in the position of the framework can be compensated for by means of two movable joint couplings.

Benzine is the most suitable motive power for aerial navigation. Electricity cannot be used, for the necessary accumulators are far too heavy. Hydrocarbon vapors, to be sure, are highly inflammable, and their use in airships provided with gas-bags is therefore attended with much danger. But the benzine motors, in the present instance, have been so carefully constructed that there is no danger of fire. Moreover, the lower side of the balloon-cylinder immediately above the cars has been covered with fireproof material. The cars are connected by a passage two feet wide which rest on T-rails and which are tied together with aluminium wire. The crew of five men can thus pass from one car to the other. Beneath the cars and connecting passage a cable is loosely suspended, to which a sliding weight is secured. By adjusting the position of the weight the ends of the ship can be raised or lowered. When the weight is shifted to the rear, the forward end of the airship is raised, and the air pressing on the under surface, as in a kite, will force the vessel upward. When the weight is shifted to the front, the rear end is elevated, and the ship will descend owing to the pressure of the air on its upper surface.

The first trials of the ship are soon to be made. The supporting cylindrical body is almost completed; and only the pointed ends are still to be placed in position. The cars, motors, propellers, and accessory apparatus will be shipped to the housing ready to be mounted, an operation which will require but a few days.

MECHANICAL SCIENCE.

Opening Address by Sir William White, K.C.B., LL.D., F.R.S., President of the Mechanical Science Section, British Association.

In this address it is proposed to review briefly the characteristic features of the progress made in steam navigation; to glance at the principal causes of advance in the speeds of steamships and in the lengths of the voyages on which such vessels can be successfully employed; and to indicate how the experience and achievement of the last sixty years bear upon the prospects of further advance.

There is reason to hope that this choice of subject is not inappropriate. From the beginning of steam navigation the British Association in its corporate capacity, by the appointment of special committees, and by the action of individual members, has greatly assisted the scientific treatment of steamship design. Valuable contributions bearing on the resistance offered by water to the motion of ships, the conduct and analysis of the results of steamship trials, the efficiency of propellers and cognate subjects have been published in the Reports of the Association. Many of these have largely influenced practice, and most of them may be claimed as the work of this Section.

On this occasion no attempt will be made either to summarize or appraise the work that has been done. It must suffice to mention the names of three men to whom naval architects are deeply indebted, and whose labors are ended—Scott Russell, Rankine, and William Froude. Each of them did good work, but to Froude we owe the device and application of the method of model experiment with ships and propellers, by means of which the design of vessels of novel types and unprecedented speeds can now be undertaken with greater confidence than heretofore.

As speeds increase, each succeeding step in the ascending scale becomes more difficult, and the rate of increase in the power to be developed rapidly augments. Looking back on what has been achieved, it is impossible to overrate the courage and skill displayed by the pioneers of steam navigation, who had at first to face the unknown, and always to depend almost entirely on experience gained with actual ships, when they undertook the production of swifter vessels. Their successors of the present day have equal need to make a thorough study of the performances of steamships both in smooth water and at sea. In many ways they have to face greater difficulties than their predecessors, as ships increase in size and speed. On the other hand, they have the accumulated experience of sixty years to draw upon, the benefit of improved methods of trials of steamships, the advantage of scientific procedure in the record and analysis of such trials and the assistance of model experiments.

Steamship design to be successful must always be based on experiment and experience as well as on scientific principles and processes. It involves problems of endless variety and great complexity. The services to be performed by steamships differ in character, and demand the production of many distinct types of ships and propelling apparatus. In all these types, however, there is one common requirement—the attainment of a specified speed. And in all types there has been a continuous demand for higher speed.

Stated broadly, the task set before the naval architect in the design of any steamship is to fulfill certain conditions of speed in a ship which shall not merely carry fuel sufficient to traverse a specified distance at that speed, but which shall carry a specified load on a limited draught of water. Speed, load, power and fuel supply are all related; the two last have to be determined in each case. In some instances other limiting conditions are imposed affecting length, breadth or depth. In all cases there are three separate efficiencies to be considered; those of the ships as influenced by her form; of the propelling apparatus, including the generation of steam in the boilers and its utilization in the engines; and of the propellers. Besides these considerations, the designer has to take account of the materials and structural arrangements which will best secure the association of lightness with strength in the hull of the vessel. He must select those types of engines and boilers best adapted for the service proposed. Here the choice must be influenced by the length of the voyage, as well as the exposure it may involve to storm and stress. Obviously the conditions to be fulfilled in an ocean-going passenger steamer of the highest speed, and in a cross-Channel steamer designed to make short runs at high speed in comparatively sheltered waters, must be radically different. And so must be the conditions in a swift sea-going cruiser of large size and great coal endurance, from those best adapted for a torpedo boat or destroyer. There is, in fact, no general rule applicable to all classes of steamships; each must be considered and dealt with independently, in the light of the latest experience and improvements. For merchant ships there is always the commercial consideration—Will it pay? For warships there is the corresponding inquiry—Will the cost be justified by the fighting power and efficiency?

CHARACTERISTICS OF PROGRESS IN STEAM NAVIGATION.

Looking at the results so far attained, it may be said

that progress in steam navigation has been marked by the following characteristics:

1. Growth in dimensions and weights of ships, and large increase in engine power, as speeds have been raised.

2. Improvements in marine engineering accompanying increase of steam pressure. Economy of fuel and reduction in the weight of propelling apparatus in proportion to the power developed.

3. Improvements in the materials used in shipbuilding; better structural arrangements; relatively lighter hulls and larger carrying power.

4. Improvements in form, leading to diminished resistance and economy of power expended in propulsion.

These general statements represent well-known facts—so familiar, indeed, that their full significance is often overlooked. It would be easy to multiply illustrations, but only a few representative cases will be taken.

TRANSATLANTIC PASSENGER STEAMERS.

The Transatlantic service naturally comes first. It is a simple case, in that the distance to be covered has remained practically the same, and that for most of the swift passenger steamers cargo-carrying capacity is not a very important factor in the design.

In 1840 the Cunard steamship "Britannia," built of wood, propelled by paddle-wheels, maintained a sea-speed of about 8½ knots. Her steam pressure was 12 lb. per square inch. She was 207 feet long, about 2,000 tons in displacement, her engines developed about 750 horse power, and her coal consumption was about 40 tons per day, nearly 5 lb. of coal per indicated horse power per hour. She had a full spread of sail.

In 1871 the White Star steamship "Oceanic" (first of that name) occupied a leading position. She was iron built, propelled by a screw, and maintained a sea-speed of about 14½ knots. The steam pressure was 65 lb. per square inch, and the engines were on the compound principle. She was 420 feet long, about 7,200 tons in displacement, her engines developed 3,000 horse power, and she burnt about 65 tons of coal per day, or about 2 lb. per indicated horse power per hour. She carried a considerable spread of sail.

In 1889 the White Star steamer "Teutonic" appeared, propelled by twin screws and practically with no sail power. She is steel built, and maintains a sea speed of about 20 knots. The steam pressure is 180 lb. per square inch, and the engines are on the triple expansion principle. She is about 565 feet long, 16,000 tons displacement, 17,000 horse power indicated, with a coal consumption of about 300 tons a day, or from 1·6 to 1·7 lb. per indicated horse power per hour.

In 1894 the Cunard steamship "Campania" began her service, with triple expansion engines, twin screws and no sail power. She is about 600 feet long, 20,000 tons displacement, develops about 28,000 horse power at full speed of 22 knots, and burns about 500 tons of coal per day.

The new "Oceanic," of the White Star Line, is just beginning her work. She is of still larger dimensions, being 685 feet in length and over 25,000 tons displacement. From the authoritative statements made, it appears that she is not intended to exceed 22 knots in speed, and that the increase in size is to be largely utilized in additional carrying power.

The latest German steamers for the Transatlantic service are also notable. A speed of 22½ knots has been maintained by the "Kaiser Wilhelm der Grosse," which is 25 feet longer than the "Campania." Two still larger steamers are now building. The "Deutschland" is 660 feet long and 23,000 tons displacement; her engines are to be of 33,000 horse power, and it is estimated she will average 23 knots. The other vessel is said to be 700 feet long, and her engines are to develop 36,000 horse power, giving an estimated speed of 23½ knots. All these vessels have steel hulls and twin screws. It will be noted that to gain about three knots an hour nearly 50 per cent. will have been added to the displacement of the "Teutonic," the engine power and coal consumption will be doubled, and the cost increased proportionately.

Sixty years of continuous effort and strenuous competition on this great "ocean ferry" may be summarized in the following statement. Speed has been increased from 8½ to 22½ knots; the time on the voyage has been reduced to about 38 per cent. of what it was in 1840. Ships have been more than trebled in length, about doubled in breadth, and increased tenfold in displacement. The number of passengers carried by a steamship has been increased from about 100 to nearly 2,000. The engine power has been made forty times as great. The ratio of horse power to the weight driven has been increased fourfold. The rate of coal consumption (measured per horse power per hour) is now only about one-third what it was in 1840. To drive 2,000 tons weight across the Atlantic at a speed of 8½ knots, about 550 tons of coal were then burnt; now, to drive 20,000 tons across at 22 knots, about 3000 tons of coal are burnt. With the low pressure of steam and heavy slow-moving paddle engines of 1840, each ton weight of machinery, boilers, etc., produced only about 2 horse power for continuous working at sea. With modern twin screw engines and high steam pressure, each ton weight of propelling apparatus produces from 6 to 7 horse power. Had the old rate of coal consumption continued, instead of 3000 tons of coal, 9000 tons would have been required for a voyage at 22 knots. Had the engines been proportionately as heavy as those in use sixty years ago, they would have weighed about 14,000 tons. In other words, machinery, boilers, and coals would have exceeded in weight the total weight of the "Campania" as she floats to-day. There could not be a more striking illustration than this of the close relation between improvements in marine engineering and the development of steam navigation at high speeds.

Equally true is it that this development could not have been accomplished but for the use of improved materials and structural arrangements. Wood as the principal material for the hulls of high-powered swift steamers imposed limits upon dimensions, proportions and powers which would have been a bar to progress. The use of iron, and later of steel, removed those limits. The percentage of the total displacement devoted to hull in a modern Atlantic liner of the largest size is not much greater than was the corresponding percentage in the wood-built Britannia of 1840, of one-third the length and one-tenth the total weight.

Nor must it be overlooked that with increase in dimensions have come considerable improvements in form, favoring economy in propulsion. This is distinct from the economy resulting from increase in size, which Brunel appreciated thoroughly half a century ago when he designed the Great Britain and the Great Eastern. The importance of a due relation between the lengths of the "entrance" and "run" of steamships and their intended maximum speeds, and the advantages of greater length and fineness of form as speeds are increased, were strongly insisted upon by Scott Russell and Froude. Naval architects, as a matter of course, now act upon the principle, so far as other conditions permit. For it must never be forgotten that economy of propulsion is only one of many desiderata which must be kept in view in steamship design. Structural weight and strength, seaworthiness and stability, all claim attention, and may necessitate modifications in dimensions and form which do not favor the maximum economy of propulsion.

SWIFT PASSENGER STEAMERS FOR LONG VOYAGES.

Changes similar to those described for the Transatlantic service have been in progress on all the great lines of ocean traffic. In many instances increase in size has been due, not only to increase in speed, but to enlarged carrying power and the extension of the lengths of voyages. No distance is now found too great for the successful working of steamships, and the sailing fleet is rapidly diminishing in importance. So far as long-distance steaming is concerned, the most potent factor has undoubtedly been the marvelous economy of fuel that has resulted from higher steam pressures and greater expansion. In all cases, however, advances have been made possible, not merely by economy of fuel, but by improvements in form, structure and propelling apparatus, and by increased dimensions.

Did time permit, this might be illustrated by many interesting facts drawn from the records of the great steamship companies which perform the services to the Far East, Australia, South America and the Pacific. As this is not possible, I must be content with a brief statement regarding the development of the fleet of the Peninsular and Oriental Company.

The paddle steamer "William Fawcett" of 1829 was about 75 feet long, 200 tons displacement, of 60 nominal horse power (probably about 120 indicated horse power), and in favorable weather steamed at a speed of 8 knots. Her hull was of wood, and, like all the steamers of that date, she had considerable sail power.

In 1853 the "Himalaya" iron-built screw steamer of this line was described as "of larger dimensions than any then afloat, and of extraordinary speed." She was about 340 feet long, over 4,000 tons load displacement, 2,000 indicated horse power on trial, with an average sea-speed of about 12 knots. The steam pressure was 14 pounds per square inch, and the daily coal consumption about 70 tons. This vessel was transferred to the Royal Navy and did good service as a troopship for forty years.

In 1893 another "Himalaya" was added to the company's fleet. She was steel-built, nearly 470 feet long and 12,000 tons load displacement, with over 8,000 indicated horse power and a capability to sustain 17 to 18 knots at sea on a daily consumption of about 140 tons of coal. The steam pressure is 160 pounds per square inch, and the engines are of the triple expansion type.

Comparing the two "Himalayas," it will be seen that in forty years the length has been increased about 40 per cent., displacement trebled, horse power quadrupled and speed increased about 50 per cent. The proportion of horse power to displacement has only been increased as three to four, enlarged dimensions having secured relative economy in propulsion. The rate of coal consumption has been probably reduced to about one-third of that in the earlier ship.

The latest steamers of the line are of still larger dimensions, being 500 feet long and of proportionately greater displacement. It is stated that the "Himalaya" of 1853 cost £132,000 complete for sea; the corresponding outlay on her successors is not published, but it is probably twice as great.

On the service to the Cape similar developments have taken place. Forty years ago vessels less than 200 feet long and about 7 knots performed the service, whereas the latest additions to the fleet exceed 500 feet in length, and can, if required, be driven at 17 to 18 knots, ranking in size and power next to the great Transatlantic liners.

Commercial considerations necessarily regulate what is undertaken in the construction of merchant steamers, including the swift vessels employed in the conveyance of passengers and mails. The investment of £600,000 to £700,000 in a single vessel like a great Transatlantic liner is obviously a serious matter for private owners; and even the investment of half that amount in a steamer of less dimensions and speed is not to be lightly undertaken. It is a significant fact that whereas fifteen years ago nearly all the largest and swiftest ocean steamers were British built and owned, at the present time there is serious competition in this class by German, American and French companies. It is alleged that this change has resulted from the relatively large subsidies paid by foreign governments to the owners of swift steamers; and that British owners being handicapped in this way cannot continue the competition in size and speed on equal terms unless similarly assisted. This is not the place to enter into any discussion of such matters, but they obviously involve greater considerations than the profit of shipowners, and have a bearing on the naval defense of the empire. In 1887 the government recognized this fact, and made arrangements for the subvention and armament of a number of the best mercantile steamships for use as auxiliary cruisers. Since then other nations have adopted the policy, and given such encouragement to their shipowners that the numbers of swift steamers suitable for employment as cruisers have been largely increased. Not long since the First Lord of the Admiralty announced to Parliament that the whole subject was again under consideration.

CARGO AND PASSENGER STEAMERS.

Cargo steamers, no less than passenger steamers, have been affected by the improvements mentioned. Remarkable developments have occurred recently, not merely in the purely cargo-carrier, but in the construction of vessels of large size and good speed carrying very great weights of cargo and considerable numbers of passengers. The much decried "ocean-tramp" of the present day exceeds in speed the passenger and mail steamer of fifty years ago. Within ten years vessels in which cargo-carrying is the chief element of commercial success have been increased in length from 300 or 400 feet to 500 or 600 feet; in gross register tonnage from 5,000 to over 13,000 tons; and in speed from 10 or 12 knots to 15 or 16 knots. Vessels are now building for the Atlantic service which can carry 12,000 to 13,000 tons deadweight, in addition to passengers, while possessing a sea-speed as high as that of the swiftest mail steamers afloat in 1880. Other vessels of large carrying power and good speed are running on much longer voyages, such as to the Cape and Australia. In order to work these ships successfully, very complete organization is necessary for the collection, embarkation and discharge of cargo. The enterprise and skill of shipowners have proved equal to this new departure, as they have in all other developments of steamships.

How much further progress will be made in the sizes and speeds of these mixed cargo and passenger steamers cannot be foreseen. The limits will be fixed by commercial considerations, and not by the capability of the shipbuilder.

In passing, it may be noted that while the lengths and breadths of steamships have been greatly increased, there has been but a moderate increase in draught. Draught of water is, of course, practically determined by the depths available in the ports and docks frequented, or in the Suez Canal for vessels trading to the East. From the naval architect's point of view, increase in draught is most desirable as favoring increase of carrying power and economy of propulsion. This fact has been strongly represented by shipowners and ship-designers, and not without result. The responsible authorities of many of the principal ports and of the Suez Canal have taken action toward giving greater depth.

Other changes have become necessary on the part of dock and port authorities in consequence of the progress made in shipbuilding. Docks and dock-entrances have had to be increased in size, more powerful lifting appliances provided and large expenditure incurred. There is no escape from these changes if the trade of a port is to be maintained. The chief lesson to be learnt from past experience is that when works of this character are planned, it is wise to provide a large margin beyond the requirement of existing ships.

CROSS-CHANNEL STEAMERS.

The conditions to be fulfilled in vessels designed to steam at high speed for limited periods differ essentially from those holding good in ocean-going steamers. None the less interest attaches, however, to cross-channel steamers, and in no class has more notable progress been made. It is much to be desired that at this meeting some competent authority should have presented to the association an epitome of the history of the steam packet service between Dover and the Continent. I cannot attempt it. So far as I am informed, the first steamer was placed on this route in 1821, was of 90 tons burden, 30 horse power nominal, and maintained a speed of 7 to 8 knots. She was built by Denny, of Dumbarton, engined by David Napier, and named the "Rob Roy." It is interesting to note that the lineal successors of the builder of this pioneer vessel have produced some of the most recent and swiftest additions to the cross-channel service.

In 1861-2 a notable advance was made by the building of vessels which were then remarkable for structure and speed, although small and slow when compared with vessels now running. Their designers realized that lightness of hull was of supreme importance, and with great trouble and expense obtained steel of suitable quality. The machinery was of special design and relatively light for the power developed. A small weight of coal and cargo had to be carried, and the draught of water was kept to about 7 feet. Under then existing conditions it was a veritable triumph to attain speeds of 15 to 16 knots in vessels only 190 feet long, less than 25 feet broad, and under 350 tons in displacement. To raise the trial speed to 20 or 21 knots in later vessels performing the same service, whose design includes the improvements of a quarter of a century, it has been found necessary to adopt lengths exceeding 320 feet and breadths of about 35 feet, with engines developing 4,500 to 6,000 indicated horse power, and with very great increase in coal consumption and cost. On other cross-channel services between Dover and the Continent still larger and more powerful paddle steamers are employed.

Another interesting contrast is to be found in the comparison of the steamers running between Holyhead and Kingstown in 1860 and at the present time. The "Leinster" of 1860 was 328 feet long, 35 feet broad, and rather less than 13 feet draught. Her trial displacement was under 2,000 tons, and with 4,750 horse power she made 17¾ knots. She had a steam pressure of 25 pounds per square inch and was propelled by paddle wheels driven by slow-moving engines of long stroke. Her successor of 1896 is about 30 feet greater length, 6½ feet greater breadth, and about 10 per cent. greater displacement. The steam pressure is 170 pounds per square inch. Forced draught is used in the stokeholds. Twin screws are adopted, driven by quick-running vertical engines of the triple expansion type. Very great economy of coal consumption is thus secured as compared with the earlier vessel, and much lighter propelling apparatus in proportion to the power, which is from 8,000 to 9,000 horse power at the full speed of 23 knots. The hull is built of steel, and is proportionately lighter.

This is a typical case, and illustrates the effect of improvements in shipbuilding and engineering in thirty-five years. The later ship probably requires to carry no greater load of coal than, if so great as, her predecessor, although her engine power is nearly double. The weight devoted to propelling machinery and boilers is probably not so great. Thanks to the use of steel instead of iron, and to improved structural arrangements, the weight of hull is reduced in comparison with dimensions, and a longer ship is produced better

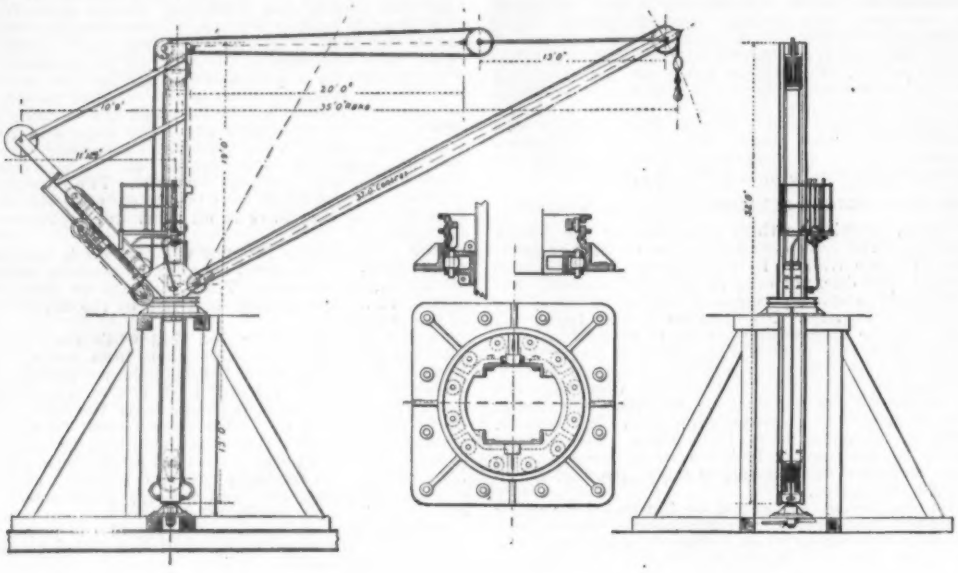
adapted to the higher speed. Messrs. Laird, of Birkenhead, who built three of the "Leinster" class forty years ago, and have built all the new vessels, are to be congratulated on their complete success.

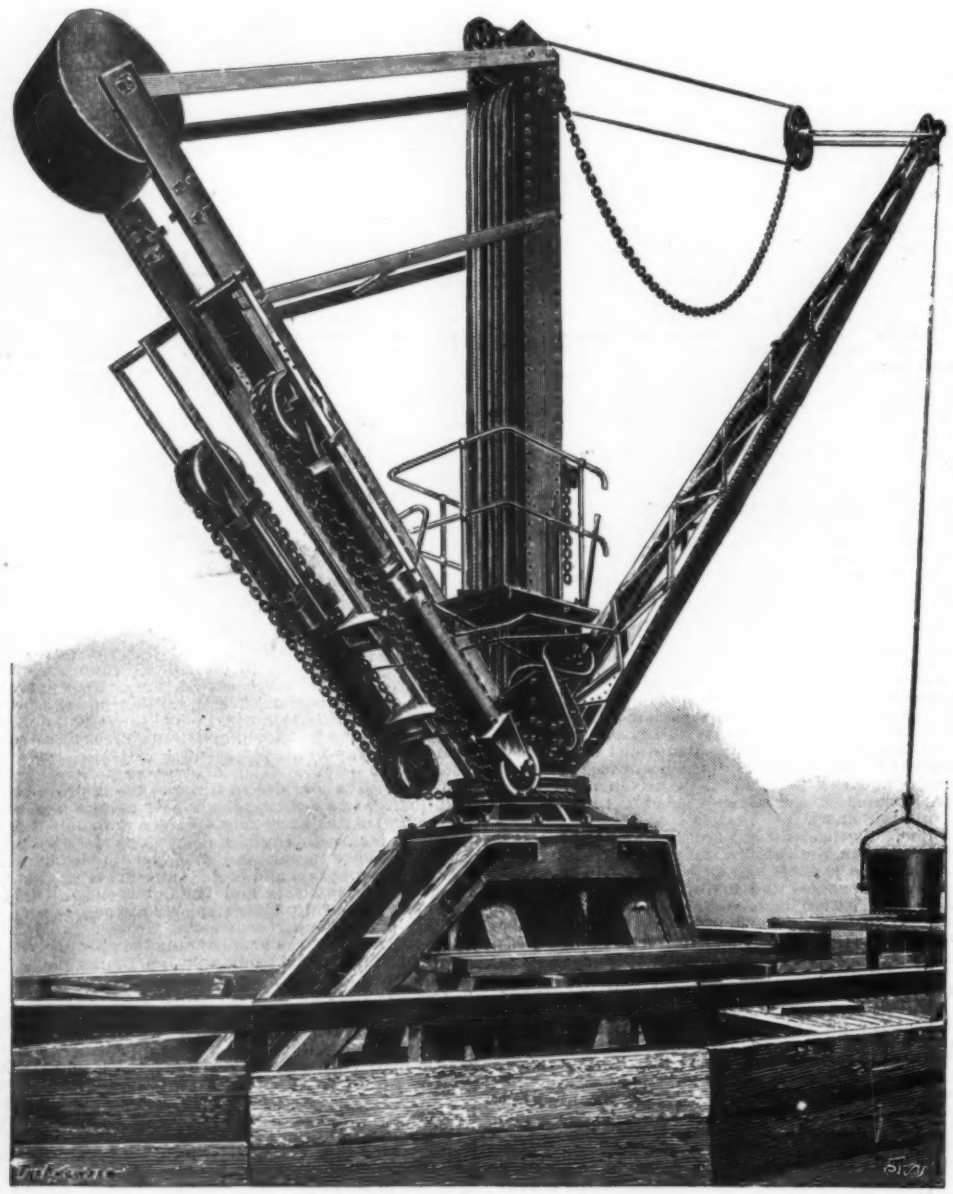
Between such vessels designed for short runs at high speed and requiring therefore to carry little coal, while the load carried exclusive of coal is trifling, and an ocean-going steamer of the same average speed designed to make passages of 3,000 miles, there can obviously be little in common. But equal technical skill is required to secure the efficient performance of both services. In the cross-Channel vessel, running from port to port, and under constant observation, conditions of working in engine and boiler rooms, as well as relative lightness in scantlings of hull, can be accepted which would be impossible of application in a sea-going ship. These circumstances in association with the small load carried explain the apparent gain in speed of the smaller vessel in relation to her dimensions.

(To be continued.)

HYDRAULIC JIB CRANE.

The accompanying illustration shows a jib crane, worked by hydraulic power, of the type that is being used by Messrs. Perry & Company on the Baker Street and Waterloo electric underground railway contract. The crane is of the independent type, and is carried upon a foundation plate, having ball bearings; an upper foundation plate is fixed 14 feet above the footstep, and is provided with a circular roller path which surrounds the crane mast. The jib is raised and lowered by means of hydraulic power, and allows of a rake varying from 20 feet to 35 feet. The turning or slewing gear is also worked by hydraulic power, and is arranged so as to move the jib through a complete circle. The hoisting gear raises a load of 1½ tons, 120 feet high, at a speed of 180 feet per minute. Other particulars will be readily gathered from the drawing given herewith. The crane shown in the illustration is fixed at the Piccadilly Circus Station site, and is used for the purpose of raising the clay and ballast from the tunnels, and also for delivering the iron segments, etc., required in the tunneling operations. Fixed in the midst of offices and other buildings, and being in operation by night as well as by day, this method of using hydraulic power is very advantageous on account of its silent working, and also the entire freedom from smoke. The crane was made by the Leeds Engineering and Hydraulic Company, of Providence Works, Cross Stamford Street, Leeds.—The Engineer.





HYDRAULIC JIB CRANE.

PULVERIZED FUEL.

The attention which is now being directed toward the prevention of smoke in connection with the generation of power by the combustion of coal has awakened renewed interest in the possibilities of pulverized fuel. An exhaustive review of the past and present practice in this branch of engineering appears in a series of articles in the Schweizerische Bauzeitung, and in view of the schemes which have recently been discussed, this review is of present value.

Pulverized fuel has been the subject of experiment since 1831, when Henschel, at Cassel, charged air with coal dust and used it for firing brick kilns, and for welding and other smithy operations. Nearly thirty years later Pütsch attempted to use coal-dust firing for glass furnaces in England, and in the 70's Crampton made a number of applications of the principle to metallurgical operations.

In America the experiments of McAuley about 1881, and Hathaway in 1886, are well known, and at the present time the experiences of Wegener and others in Germany and elsewhere are attracting considerable attention.

Three fundamental principles are laid down for the successful use of pulverized coal as fuel. (1) The combustion chamber must be maintained at a high temperature; (2) the powdered fuel must be delivered into the midst of the entering air current, and the intimate mixture of air and fuel delivered into the combustion chamber in an uninterrupted stream; (3) the particles of coal must be maintained suspended in the air until they are fully consumed.

This last condition is very important, since if the particles fall out of the air current to the bottom of the combustion chamber, mere coking will take place instead of a complete combustion.

A distinction must be made between powdered fuel and the ordinary coal dust which is found at every mine. The coal for use in air-blast firing without grates must be finely ground in a mill, so that it will pass a sieve of 900 meshes per square centimeter, and must be entirely free from any larger particles.

The first of the above conditions requires especial consideration in connection with internally-fired boilers, since the proximity of boiler surface to the burning dust will chill the furnace to an extent sufficient to make the combustion imperfect. In order to avoid this, it is necessary to line the furnace with fire-brick, which by attaining a high temperature prevents the chilling of the flame and acts to equalize the temperature. There is no loss of heat by using such a lining, as the fire-brick occupies only an intermediate position and the heat is ultimately transferred to the boiler surface.

The second condition, that of mixing the fuel with air and feeding the mixture into the combustion space, is the one which must be fulfilled by the construction of the apparatus, and the ingenuity of designers is mainly exerted in this direction.

The third condition is mainly dependent upon the fineness of pulverization, and it is the cost of grinding the coal to the necessary degree of fineness which usually limits the commercial application of any process.

The Wegener furnace, about which much has been said of late, is an attempt to apply pulverized coal methods similar to those which have been used successfully with low-grade hydrocarbons, and with petroleum refuse, in Russia. In this apparatus the finely powdered coal is distributed into the incoming air by a revolving sieve, and the mixture is then driven into the combustion chamber by a steam jet. A fire-brick lining permits the high temperature to be maintained, and as this soon becomes white hot, any slight inequality in the rate of firing does not permit a sudden chilling. The ash which exists in the coal is mostly fused to a liquid slag, which runs out a tap hole below, and it is found that there is no greater accumulation of dust in the boiler flues than occurs with ordinary firing.

A number of tests, conducted with especial regard to smoke prevention, have been made in Germany, and the details of these do not show any extraordinary evaporative performance, from eight to nine pounds of water per pound of coal being the average result. The absence of smoke was practically attained in all cases, however, whenever proper precautions were taken to provide sufficient fire-clay surface in the combustion chamber to prevent chilling of the flame. This has been found difficult of accomplishment in the case of water-tube boilers, unless an entirely separate combustion furnace is constructed, since the presence of the tubes containing water checks the combustion to an extent sufficient to cause smoke to be produced.

The use of pulverized fuel can hardly be recommended on the score of economy, as the evaporation is little if any higher than that obtained by ordinary firing, while at the same time the cost of grinding the coal must be included. When, however, it is imperative that no smoke be produced, it appears that this is one of the various methods by which that desirable result may be attained.—Engineering Magazine.

UTILIZATION OF BELGIAN PEAT.

At the instance of the Belgian Government Departments of Forestry and Agriculture an investigation of the numerous peat mosses in that kingdom has been made by A. Petermann, says the Bulletin de l'Association Belge des Chemistes. In the state forests of Hertogenwald and Freyr (Ardennes), the peat is comparatively rich in nitrogen, the average content, referred to perfectly dry matter, being 1·8 per cent. The material contains too small a proportion of fiber to be suitable for use as litter, but, owing to its ligneous character and the presence of woody residues, it seems well adapted for distillation in closed retorts; and in fact 1,000 kgs.

(air dry treated in this manner at a temperature of about 450°) yielded the following products: Coke, 337·5 kgs.; tar, 57·665 kgs.; acetic acid, 3·058 kgs.; methyl alcohol, 600 c. c. The tar, when subjected to fractional distillation, furnished: Oil distilling below 100° C., 2·5 kgs.; between 100° and 200°, 12·75 kgs.; between 200° and 300°, 17·00 kgs.; paraffin, 14·425 kgs.; carbon, 11·00 kgs. The quantity of ammonia produced, 921 grms. (= 3,630 grms. of sulphate of ammonia) is much less than the nitrogen content of the peat presaged. In addition, cyanides formed from the distillation of the organic bases were detected in the carbon, and a considerable volume of illuminating gas was evolved, 2 kgs. of peat in one experiment having produced enough gas to supply one jet for six hours. The peat found in the plains of Campine is of a different nature, being earthy and containing from 28 to 60 per cent. of ash, as compared with the average 5 per cent. or so yielded by the Ardennes peat. It is, however, suitable for use as fuel locally, and for mixing with litter, the power of absorption for water being high, as is also the proportion of manurial ingredients.

PHOTOGRAPHIC NOVELTIES.

AMATEUR photographers are generally more familiar with glass plates than with films. The manipulation of the latter daunts them to a certain extent, notwithstanding the fact that the treatment is not very complicated. It must be admitted, however, that the development of a negative upon glass is easier, and we advise beginners to commence therewith. Afterward, they may pass from one to the other, according to circumstances. In traveling, the film will always have the advantage of lightness, strength and compactness. It is with the object of satisfying every one that M. Cadot has devised a small transformable hand apparatus that permits of the use of either a glass plate or a film wound upon a spool, as may be desired. The dimensions of the images upon glass are 3½ × 4½ inches; those of the images upon the film are slightly smaller. They are the English dimensions that come nearest to 3½ × 4½ inches, and have been chosen by M. Cadot because they are the ones most employed, and because spools of this size are found already prepared in the market. The apparatus (Fig. 1, No. 1) has the form of a square box, and is of the kind well known under the name of "Detective." It is provided with an objective fitted with a variable speed shutter that does not expose the plate during adjustment, and it has two finders that locate the image for an upright or lengthwise position of the plate. When the apparatus is opened at the back, we find inside of it an arrangement for the reception of the spool of film, which can be put in place in broad daylight. To effect this it suffices to remove the spindle, *A* (Fig. 1, No. 2), and place the spool upon it, and then put it back in the same position. After this, the end of the strip is unwound and passed under the guides that are to keep level the part opposite the objective, and is finally fastened in the slit of the roller, *B*. It is clear that this part of the film is sacrificed; but this is of no consequence, since it is not sensitized. The apparatus is now closed and the key is turned while the operator is looking through the aperture in the shutter, *V*, opposite the spyglass, *L*, provided with a red glass. As soon as the figure, *I*, is seen to appear, the sensitized part for the first negative is in place. It suffices to turn the key in the same manner for the twelve negatives that the roller, *B*, is capable of receiving, and then to continue to wind the black part that terminates the film. After this the apparatus may be opened and the spool be replaced by another.

If it be desired to employ ordinary plates, the key, *C*, is unscrewed by turning it from left to right, and is then removed, and, along with it, the part designed to receive the film. We then have the well-known apparatus in which the plates, placed vertically, one behind another in small sheet iron holders, fall horizontally, one by one, on the bottom of the box as the handle placed at the side is operated. The holders, once at *P*, may remain there even when the operator is making use of spools of film. At the moment of putting the holders in place, the aperture, *V*, should be closed by means of the disk, *R*, which is provided with a bayonet catch and a spring for holding the holders in position and pushing them toward the objective.

The counter, *D*, constantly indicates how many negatives have been made. This is an apparatus that may happen to satisfy those who are hesitating between the plate and film.

Among what are called stereoscopic apparatus, we have in Fig. 2 a modification due to M. Breton, who thinks that the systems of plate shifting usually employed (and which consist in causing the holders to slide one over the other by the substitution of a new plate for the one just exposed) must necessarily cause accidents such as the scratching of the sensitized coating. Although every precaution may be taken to prevent this, it is possible that such a thing may sometimes occur in ordinary apparatus. In the Breton system, however, no such accident can happen, since the holders never slide over one another. The package, *P*, which they form is placed in a frame, *C* (Fig. 2, No. 3), which is pivoted upon studs. One of the plates is seized by clutches which hold it outside of the frame while the latter is revolving, and it thus passes from front to rear. In order to obtain such a result, the back, *A*, of the apparatus is pulled out and shoved in by means of the leather handle with which it is provided (Fig. 2, No. 2). In this way, a half revolution is given the frame, *C*, and plate No. 1, which has just been exposed, is consequently turned against the bottom of the apparatus, where it is held by the clutches, while the back, *A*, is pulled out and shoved in anew. This time the frame, *C*, again makes a half revolution, and it is now plate No. 2 that is opposite the objective. Plate No. 1, upon being released by the clutches that held it, places itself at the rear of the package, against plate No. 12, where it is held by other clutches. The system is very ingenious, and the motion of the clutches that seize the frame and release it at the desired moment is very interesting. The camera (Fig. 2, No. 1) to which the inventor applies his method of changing the plates is provided with Zeiss objective of 5¼ inch focus and 0·65 inch opening. The shutter, which is placed behind, permits of several speeds and presents the peculiarity of giving short exposures with stoppages regulatable in advance. For operating in a feeble light, this is a very advantageous feature. The focusing is done through a double rack by maneuvering a button placed at the side. A finder, *H*, permits of operating at the level of the breast, and another one, *V*, permits of obtaining a view while holding the apparatus at the level of the eyes. The number of plates that have been exposed is indicated by a counter.

We have often heard the regret expressed that magazine hand cameras do not permit of throwing the objective out of center, and this is very annoying when a person cannot move back far enough to take a view of a building of some little height. Several manufacturers have now remedied this state of things, and mount the objectives upon slides that permit of throwing them out of center in both directions. But, in order that the image may be brought exactly upon the plate, the displacement of the objective must be noted through the finder. There are several arrangements in use for this purpose, but we have been particularly struck with that of M. Gaumont, which is automatic, and which he applies to his "Spido," a 3½ × 4½ inch magazine apparatus, which, already provided with every improvement, is rendered still more perfect through the addition of the finder under consideration.

The board that carries the objective (Fig. 3) is capable of sliding in a vertical or horizontal direction, and carries along with it a front sight, *M*, which is so arranged that its extremity shall be situated in the vertical line passing through the nodal point of the objective. Such a condition being obtained by the construction, and the rear lens, *V*, that constitutes the finder being fixed, the line of sight that passes through the center (indicated by a cross) of this lens and the extremity of the front sight is always in the center of the image.

In practice, therefore, a person has nothing to concern himself about. He simply sights while holding the apparatus horizontally and moving the front sight, and consequently the objective, the necessary distance in one direction or the other to obtain the image desired. As soon as such a result is shown by the finder, the shutter is freed, and the operator may be certain that the image photographed is exactly that which he wanted.

For the above particulars and illustrations, we are indebted to La Nature.

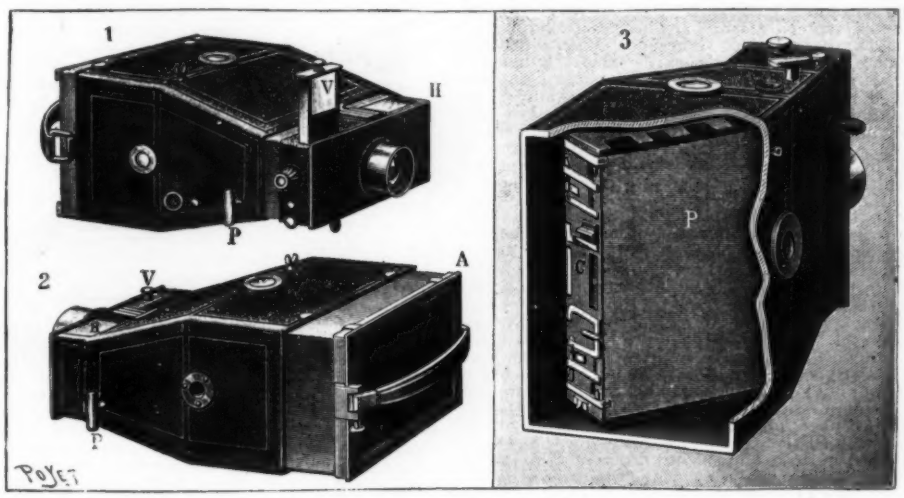


FIG. 2.—BRETON'S CAMERA, WITH ROTARY CHANGE OF PLATES.

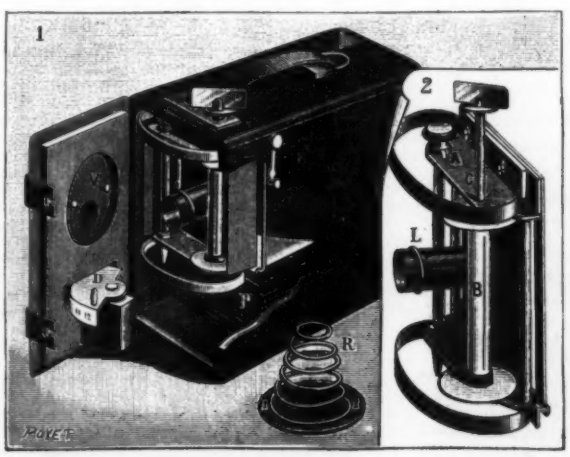


FIG. 1.—APPARATUS IN WHICH EITHER GLASS PLATES OR FILMS ON SPOOLS MAY BE USED.

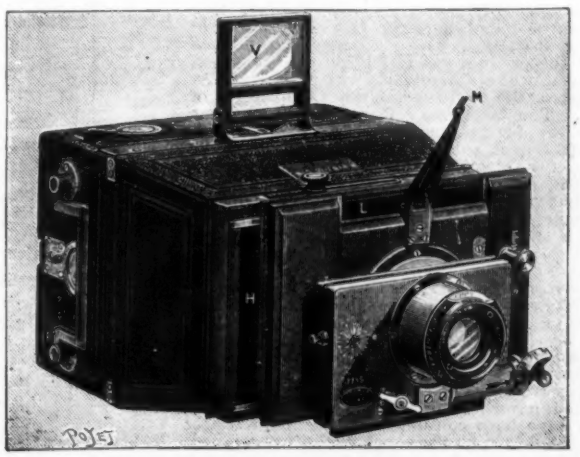


FIG. 3.—GAUMONT'S APPARATUS WITH AUTOMATIC FINDER.

AMMONIA AS A FIRE EXTINGUISHER.

THE republication in several of our exchanges, in a condensed form, of an answer given to one of our correspondents in regard to fire-extinguishing liquids, has brought us in several requests for further information on the subject. To gratify these we will state that some years ago the Union Pharmaceutique, a French journal of pharmacy, printed a communication from a M. Jenneau, pharmacist of the first class, residing in the old town of Savenay (Lower Loire), relating how he put out a fire in a dyeing and cleaning establishment which was in the same building as his pharmacy. Without side details, we shall state that in the cleaning establishment was a room containing a tank holding some 50 gallons of gasoline, beside which there was another vessel holding some 25 gallons. The vapor of gasoline was diffused throughout the room, and when a workman carelessly lighted a match, it instantly exploded, setting fire to the house.

The flames gained headway rapidly, and were leaping high above the roof, when M. Jenneau seized a demijohn containing six liters (about a gallon and a half) of ammonia and threw it into the room from a rear window or door. "The effect," says he, "was instantaneous and marvelous. Torrents of smoke burst forth and rolled upward in place of the flames, and in a moment every trace of fire was gone. So quickly and completely was combustion arrested, that workmen were able to enter the gasoline room almost immediately, and there found the tanks and other container intact—not a trace of fire remained."

Some time after reading the foregoing we happened to be present where a lot of cotton-seed refuse had caught fire spontaneously, and was burning briskly within. Desiring to test the efficacy of ammonia in this direction, a quart bottle of the strong liquor was emptied through an iron tube thrust down to the seat of combustion. The effect was instantaneous and much as described by M. Jenneau—dense black smoke forcing itself up through the mass and filling the large stable where the stuff had been dumped. Subse-

quent examination showed that every particle of the fire had been smothered by the ammoniacal gas.

Carbonic acid gas has been shown by Clowes to have an even higher fire-extinguishing value than ammonia, and (as was shown in Philadelphia a few years ago) the fountain retort may sometimes be relied upon to suppress incipient fires in drug stores.

When potassium hydrate (K O H) is moistened with aqua ammonia, there is at once set up an intense development of gaseous ammonia. Perhaps this fact may suggest a fire extinguisher of great value.

ROQUEFORT AND ITS CHEESE.

THE untiring industry and diligence of the inhabitants have transformed France, in spite of the comparative barrenness of much of its soil, into a land of beautiful gardens which yield rich harvests of fruit and vegetables; this is specially true of the neighborhood of Paris and along the banks of the Seine. Where formerly only bare, rocky ground without a trace of humus was seen, we now find fruitful soil; dry lands have been watered by means of artificial canals; swamps have been drained, and thus extensive tracts have been much improved, while no pains have been spared on other parts of the country that were more favored by nature and consequently better adapted to the cultivation of the grape vine, fruit trees, dye plants etc. Many of these districts are renowned the world over for the products of their vineyards and of their fruit trees, among which we might mention the champagne from Bordeaux, oil from Provence, and flowers and perfumes from the French Riviera. The poorer districts yield to the inhabitants very little, and even that little is obtained only by the application of all the technical knowledge and intelligence at their disposal. Among the poorest districts are the departments through which the Cevennes Mountains extend, especially Averyon, Lazarc, Rouergues, etc. Here breadstuffs will not grow, and consequently the inhabitants of this picturesque and romantic region have been compelled to gain by sheep raising the livelihood that the soil denied them. By careful treatment of the native breed of sheep and the utilization of their milk in the manufacture of cheese, the inhabitants have become prosperous and their circumstances are steadily improving.

One place in this seemingly unproductive region has gained a celebrity that extends far beyond France and even beyond Europe—we refer to Roquefort, which sends millions of pounds of cheese to all parts of the world each year. This village, which certainly is nothing but a mass of rocks, has a specialty as old as itself, extending back to the early middle ages, for from a chronicle of 1070 we learn that Fiotard de Cornus presented several pieces of land to the Cloister of Couques, with the stipulation that a yearly tribute of two ripe cheeses should be paid by each cellar in Roquefort; and in 1550 the parliament of Toulouse issued an edict with the object of protecting the quality of all cheeses made in Roquefort, giving to that village the exclusive right to make these cheeses, and at the same time laying a tax of six livres per hundredweight on anyone not living in Roquefort who undertook to make such cheese.

A clear idea of the increase in the quantity of cheese manufactured at Roquefort during the past hundred years can be gained from the following figures: the output increased from 500,000 lb. in 1800 to about 600,000 in 1820, and 1,500,000 in 1840; in 1860 it reached 5,400,000, and in 1873, 7,200,000, while the present yearly output amounts to 10,000,000 lb., to say nothing of the twenty-five out of a hundred which are thrown out as not good enough to be sent away or which did not pass successfully through the process of fermentation. This enormous product brings to the inhabitants of Roquefort more than $3,000,000 per year.

It is an interesting fact that only in Roquefort can cheese of this particular quality be produced, and this is due largely to the specially favorable location and character of the rock cellars in which the new or young cheeses made of ewes' milk have, for centuries, undergone the process of fermentation and ripening. The success of the people of Roquefort encouraged those of neighboring districts to make cheeses on the same model, but the product was inferior, in every respect, to the original, which still remains without a rival. As already stated, the Roquefort cheeses are made of ewes' milk. The farmers of Roquefort keep great flocks of sheep, for these animals are contented with scanty nourishment and are not over-sensitive to the inclemency of the weather. The attempts to acclimatize the merino sheep failed, but years of careful breeding of the native stock have produced a very valuable animal, characterized by small head and strong frame, but which is specially valued on account of the large quantity of milk given by the ewes, and its beautiful wool is also of great importance. The flocks consisting of thousands of animals subsist on the innumerable plants which grow in the hollows and on the rocky slopes; such as sage, lavender, rosemary, thyme, moss, grass, etc., all of which are aromatic and have an effect on the milk glands of the ewes. During the good seasons the sheep are left on the meadows in small flocks, being driven from one place to another by herds, but one pasture is never left for another until all the grass and herbs have been consumed. Even in the winter the sheep are driven to the meadows for a few hours, but more for the sake of giving the animals some exercise and of obtaining an opportunity for cleaning and airing their stalls. During the severe weather they are generally fed in their stalls. They are milked twice a day, in the morning before they are turned out and again after the return from pasture.

The morning's milk is mixed with that of the evening, care being taken that all the milk shall be of about the same temperature, as the future product the cheese might suffer if this precaution were neglected. After the milk has been mixed, rennet is added to it to produce the curd. In order that the rennet may always be in a perfect state of preservation and at the same time be ready for use at any time, the stomachs of lambs and kids from which it is made, after being cleansed and rubbed with salt, are thoroughly dried, and this dried material can be used by soaking in lukewarm water for four or five days, or it can be pulverized and the powder added to the milk as needed. After the rennet has been added to the milk it is well beaten so that the curd falls to the bottom of the vessel and the whey floats on the top and is poured off into another vessel. The curd thus obtained is passed into a cylindrical mould made of glazed clay which gives it the form of the future cheese or of a loaf about eight inches in diameter and three inches in height. Any whey that is still left in the curd passes off through perforations in the bottom of the mould. A peculiar powder prepared from dried bread dough is scattered over the mass in the moulds and beaten in. After this process the cheese is marble-like in whiteness with blue spots or streaks which increase during the process of fermentation. The Roquefort cheese makers attach the greatest importance to the production of this mouldy bread. It is made of flour of wheat and of summer and winter barley combined in certain proportions, strong yeast, about twenty-three hundredths of vinegar and a little water. After this dough has

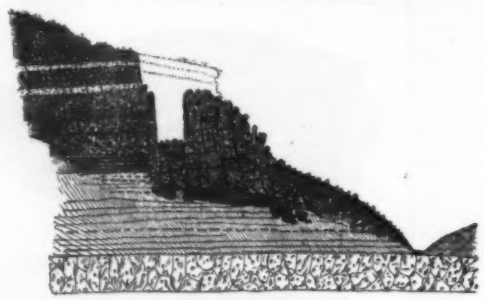


FIG. 1.—SECTION SHOWING GEOLOGICAL FORMATION OF ROQUEFORT.

been dried thoroughly by baking it is allowed to mold and then it is pulverized and used as above described.

When all the molds have been filled with the cheese mass over which the powdered bread is scattered, they are placed in a drying box for three or four days during which time the whey still left in the mass passes away so that the "young" cheeses are nearly dry and comparatively firm. After a little more drying the cheeses become still firmer so that they can be turned out of the molds and removed to one of the cellars for which Roquefort is celebrated and which give to the cheese the peculiarities of what is known on the market as "Roquefort cheese." Let us state here that Roquefort possesses 7,000 milk-giving sheep which are so carefully bred and tended that on an average each ewe gives enough milk to produce 32 to 36 lb. of cheese per year, whereas the estimates of about a hundred years ago showed that the milk of all the sheep in that

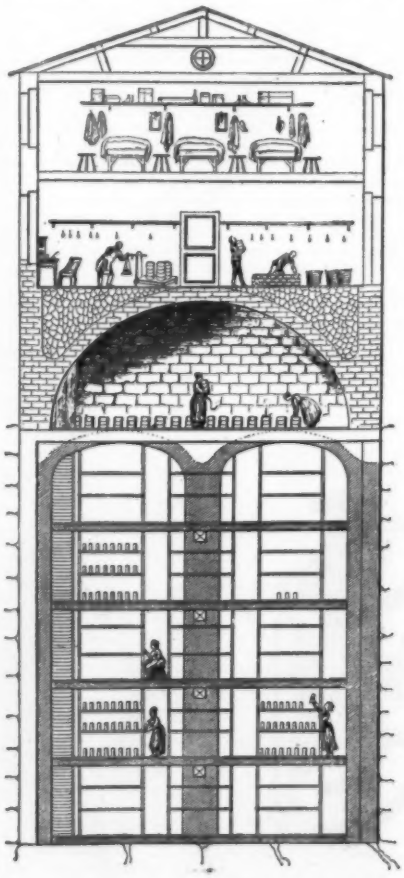


FIG. 2.—SECTION OF ROCK CELLAR IN ROQUEFORT.

region is utilized in the production of the Roquefort cheese, for so small a place could never supply the amount of milk required for the millions of pounds of cheese produced.

When the cheeses are taken to the rock cellars, each one is weighed and then they are arranged on shelves that run around the walls of the cellars. The top of each cheese is sprinkled with cooking salt and they are placed in piles of three; twenty-four hours later they are turned over and the other ends are sprinkled with salt. The salt dissolves in the damp air of the cellars and spreads over the entire cheese, thus providing the proper seasoning. This process is aided by gently beating the cheese with peculiarly shaped pieces of wood, after which the cheese is left standing for two days; then it is carried to another part of the cellar, where it is scraped to remove the thin rind that has formed on it, and the white powder thus obtained is utilized as food for hogs. The refuse, in the form of white chips or shavings, of a second scraping that follows immediately after the first one, is sold at a low price to the workmen and farmers as an article of food for themselves and their families. After the second scraping the quality of the cheese can be predicted with safety, and the "young" cheeses are separated into three classes, according to which they are arranged in rows, on bars, in different parts of the cellar. Just before a cheese has attained perfect ripeness a gray rind is formed, and the former beard-like formation of white threads is replaced by a wavy coating which is scraped off, and, like the white meal left from the first scraping, is used as a cheap article of food. After remaining in the cellar from thirty to forty days a cheese is perfectly ripe and ready for the market. The cheeses which ripen during the first working months of the year, on account of being sent from the cellar to the warm air of the summer, do not keep as well as those which ripen at the beginning of the cold season, and consequently the latter are considered much more desirable.

The temperature of the cellars is so low that the five or six hundred women who work there eight months of the year are obliged to dress very warmly, especially as they are usually seated while working. Some of these women scrape the cheeses, others beat the young cheeses, while those of another group carry out the cheeses which have been selected as ready for weighing and shipment, and still others carry in the "young" cheeses which are ready for the cellar treatment. The different operations follow one another with a certainty that has been attained only by years of practice. The storerooms are lighted during working hours by little oil lamps that the women wear on their belts.

Many cellars of the natural rock are enlarged and arched to make them more stable, and each one is divided by rows of shelves into three or more room-like spaces. Each cellar is about 8 feet high, and the shelves are carried to a height of 6½ feet. The cheeses are so arranged on the shelves that one side of each is toward the cold wall of rock. In these walls there are fissures which run back to the heart of the mountain, and through which a constant current of cold air passes, keeping the atmosphere of the cellars at a uniform, low temperature. Experience shows that the more such fissures there are in a cellar, the better it is adapted for the production of Roquefort cheese. The cellars of Roquefort are not exactly alike; the original ones were natural formations of the rock or caves with no or very little artificial addition; but as the business increased to such a remarkable extent the rock was blasted to make artificial cellars, an effort being invariably made to provide each cellar with the natural fissures above referred to, so as to obtain, as far as possible, the conditions of the natural rock cellars which have such a decided effect on the ripening of the cheeses. The temperature of the cellars varies from 40° F. to 50° F., which is the most favorable temperature for the process of fermentation, for anything lower prevents chemical action, while a higher temperature produces alcoholic or putrefactive fermentation. The humidity of the cellar air ranges from 60 to 65 per cent. From one of the accompanying engravings, showing a cross section of the rock in which these cellars are formed, a clear idea can be obtained of the strata of the rock and the fissures or air passages formed thereby; while another engraving represents a section of a large Roquefort cellar arranged in the usual manner. The cellars run from the entrance hall of the house or directly from the street back into the rock. There is generally a room back of the entrance hall from which passages lead to the cellar. The upper story contains dwelling rooms for the farmer, and when there is a ground floor it is used for weighing both the young cheeses and those which are ready for shipment. The cut also shows the usual arrangement of the storeroom for the cheeses and the shelves in the cellar.—Der Stein der Weisen.

INTARSIA.*

INTARSIA, or inlays of wood, ivory, etc., one of the most interesting of the so-called "minor" arts, has probably suffered more both from its neglect and from its abuse than any other method of decoration. At its best—kept within its proper limitations—no more delightful form of decoration was ever devised. One must, however, be confronted with a bad example in order to be able to realize how bad it can become at its worst.

Probably every existing form of art or craftsmanship has at some period of its development suffered through the ultra-cleverness of its exponents. In painting, at the present time technique (especially in France) is worshiped for its own sake, and what we think should only be regarded as a means of expression is set before the student as the end to be attained. Intarsia, like every other art, is at its best when most itself, but, except in the earliest periods of its development, its students and makers were never able to resist the temptation to wander out of their proper limits in imitation of other arts.

The reasons of the very earliest designers and craftsmen for keeping simple and pure in their designs and patterns did them little credit, as they were probably merely mechanical reasons, and arose out of the difficulty of producing elaborate work by the only methods known to them at that time.

To a designer who has taken the thing up in the right spirit, and who has gone to the trouble of making himself even tolerably well acquainted with the resources of the craft, it would appear incredible that any one should consider it necessary to go outside its proper limitations in order to imitate any of the sister arts. The materials are so beautiful in themselves, so infinitely varied, and so adaptable to his purpose, that, assuming him to possess even a small measure of artistic instinct, his work is really half done to his hand before he draws or cuts a line. The decorative problems which present themselves to the worker in intarsia for solution are few as compared with those of the painter or sculptor. For example, he has not to concern himself with surface technique at all. Tone,

* A paper by Stephen Webb, read before the Society of Arts and printed in the Journal of that society.

harmony, and, in a limited degree, the sense of values, he must certainly cultivate. He must also be able to draw a line or combination of lines which may be ingenious if you like, but must be delicate and graceful, vigorous withal, and in proper relation to any masses which he may introduce into his design.

He must thoroughly understand the value of contrast in line and surface form, but these matters, though a stumbling block to the amateur, are the opportunities of the competent designer and craftsman—if by good hap the designer is in a position to be the craftsman also. The most charming possibilities of broken color lie ready to his hand to be merely selected by him, and introduced into his design; and yet, with these and other advantages peculiar to work in this kind, the whole history of the art, so far as I can follow it, except in the earliest times, is a story of perverted ingenuity, the story of an art degraded more than any other by the perverseness and want of taste of its votaries. Surely in no other art has the clever, sometimes exquisitely clever, craftsman suffered so many things from the bad or perverted taste of the designer. Whether the craftsman has been his own designer or has worked from the drawings of another is all one; and it makes one marvel to find the most consummate technical skill so frequently associated with that which is worst in taste and in composition.

I do not know the precise date at which the use of veneer for furniture became general, but I have little doubt that what may be termed the "fatal facility" which this afforded to the craftsman must have suggested the over-elaboration which had been practically impossible through the limitations imposed by the earlier methods.

The earliest examples of inlaid work, viz., those in which the ground is cut away and the pattern inserted into the solid wood, will nearly always be found to be good of their kind. The work, from its nature, could only be done at the cost of much time and labor, and this, doubtless, suggested to the executant the necessity for the elimination of everything from the design which was not absolutely necessary to the development of the motive—a condition of things which always makes for good decorative art in any material.

I doubt not that the early workers in intarsia often wrought, as the old builders are said to have sometimes builded, "better than they knew."

With the introduction of veneers or skins of wood came a complete change. The economical necessity for the reticence hitherto observed was removed, the smallest details could be introduced into a design with comparatively little difficulty or cost. Wooden pictures began to replace the former pure and appropriate decoration. All reserve was apparently thrown aside, and the tarsatoir of the period reveled in the representation of temples, gardens, figures in extravagant costumes, with wooden bodies and sometimes ivory heads or faces; and so the triumph of craftsmanship and the decadence of design may be followed through their various developments. In these the artist appears to have done his best (or worst) to outdo his predecessor or contemporary worker in the extravagant use of forms proper only to the painter or picture maker, till it touched what was perhaps its highest point of absurdity in the wooden representations of whole towns, castles, etc. We see these illustrated in the German work of the eighteenth century on panels used chiefly for the interior decoration of cabinets.

The French work of the eighteenth century is every whit as extravagant as that of Germany in another way. There is a small table in the Jones collection at the South Kensington Museum the top of which is decorated with "Boule work" (metal and ivory). In the plan of the decoration a band is used into which and on which are introduced figures in the costume of the period, curiously scalloped cloths, tassels, foliated forms, pateræ, caryatides, monkeys, squirrels, swags of flowers, baskets of flowers, masks, birds (cranes), dogs, festoons formed of petals or husks, cornucopiæ, and probably a few other properties more or less material to the scheme. If this kind of thing was ever worth doing (a matter about which I am hardly prepared to speak here), an excuse for it would surely be found in this table, which, as a piece of craftsmanship, apart from its design, is certainly one of the finest existing examples of this kind of work.

Personally, I have never been able to get up any enthusiasm for metal inlay for furniture. It is frequently very gorgeous, nearly always extravagant in design, seldom beautiful, and even if one has the fortune to get a beautiful design, it is generally difficult to bring it into harmony with any color scheme which may have been adopted for the decoration of the room.

Moreover, it is not easy to cut, though that is perhaps more a matter of time than difficulty, and it is apt to leave the ground when laid, which is a much more serious matter.

These are only mechanical difficulties. The chief trouble, and one which I confess I never have overcome to my own satisfaction, is in the selection of wood of a color and texture which shall at the same time contrast agreeably with the metal surfaces and harmonize both with the metal pattern and the ordinary colors used in the decoration of a modern room. May I venture to recommend this problem to the notice of any of my confrères who have the requisite leisure and experience to attempt its solution. The thing has never been done yet.

In studying French—and indeed all other marquetry work of nearly every period—the superiority of the workmanship to the design is still constantly in evidence. In nearly every important example which remains it is plain that the executant, so far from being guided by the designer, has been led out of his way, the obvious result being a deplorable waste of skillful craftsmanship.

Curiously enough, this want of taste shown in the selection of forms suitable to the embellishment of furniture is sometimes, and, indeed, often, found combined in the same cabinet with what one would fain believe to be evidence that the designer had the color scheme perfectly and could select the woods suitable for his purpose with the certainty of getting the effect which he had in his mind. But the almost inevitable introduction of these little bits of ivory again gives one pause, makes one doubtful whether the harmony of color in the woods was not accidental, or the effect of time, as it would seem impossible that a designer who had sufficient knowledge of the conditions necessary to produce so good a color harmony in the woods could deliberately bring himself to introduce anything so obviously disturbing to the whole scheme as these little bits of ivory always are.

It is not until the close of the fourteenth or beginning of the fifteenth century that we find intarsia used for the decoration of large surfaces, nor, indeed, till then does it appear to have been taken seriously into the consideration of artists or its possibilities recognized. Then we hear that Brunelleschi and Paolo Uccello gave lessons in perspective and tarsia to architects and others, of which Masaccio, in his paintings, and Benedetto da Majano, in his inlaid works, availed themselves.

There are certainly to be found examples of the craft in the small ivory boxes, ornamented with inlay of various colored woods, manufactured chiefly at Venice in the fourteenth century.

According to Vasari, one of the greatest names in the art is that of Fra Giovanni da Verona, who, in place of the dark and light woods of two or three tints only, used by the Majani, gave artificial colors to his wood inlay by means of waters, colored infusions, and penetrating oils. To obtain brilliant high lights he was accustomed to use delicate slips of willow. F. Vincenzo dalle Vacche is mentioned by Morreli in his Notizia as excellent in such work, particularly in the Church of San Benedetto, at Padua. Fra Rafaello da Brescia, of Monte Oliveto, ornamented the choir of San Michele. Sabba Castiglione, in his "Ricordi overro Ammaestramenti" (1562), given in Digby Watt's essay on the subject, in "The Industrial Arts of the Nineteenth Century," mentions the Legnaghi as good artists in this manner, and he speaks of the Dominican monk Fra Damiano da Bergamo, the most celebrated of the sixteenth century followers of the art. "But above all, those who can obtain them decorate their mansions with the works, rather divine than human, of Fra Damiano, . . . who excelled not only in perspective, like those other worthy masters (Fra Giovanni and Legnaghi), but in landscapes, in backgrounds, and, what is yet more, in figures, and who effected in wood as much as the great Apelles did with his pencil. I even think that the colors of these woods are more vivid, brilliant, and beautiful than those used by painters, so that these excellent works may be considered as a new style of painting without color, a thing much to be wondered at. And what adds to the marvel is that though these works are executed with inlaid pieces, the eye cannot, even by the greatest exertion, detect the joints." Thus the worthy Messer Sabba Castiglione.

The coloring in this case was produced by chemical fluids, with the aid of burned-in shadows. Damiano's best works, in which he was assisted by Fra Antonio Asinello, of the same monastic order, are not in color, but are assisted in their effect by burned shadows.

Other works of his are mentioned by Lanzi as in the Dominican Church at Bergamo, and in San Pietro da Casinensi, Perugia. Gian Francesco Capo di Ferro is spoken of as working also at Bergamo.

Other works in this manner are to be seen at the Certosa, Pavia, in the choir executed by Bartolommeo de Pola, in 1486; in the choir of the Cathedral at Siena, by Fra Giovanni da Verona; in the sacristies of San Miniato al Monte and Santa Croce, at Florence, and in the Sala del Gambia, at Perugia, the last being signed with the name of Marc Antonio Mereatelli. The tarsia work of artificially colored woods which Sabba Castiglione so eulogizes is not to be found in any of the above named works, and although the practice clearly originated in Italy, it reached its ultimate development in France and Flanders.

Probably the inlay which in its character most nearly approaches that of the Italian Damiano is the modern French work, so much of which is sent over to England in and for the decoration of piano-fortes, etc.

It has nearly all the faults so conspicuous in Damiano, and where the modern Frenchman has missed any of the weaknesses apparent in the work of the Italian he has more than made up for it by those which he has invented for himself. Here is evident the same struggle to obtain the effect of painting, and an equal anxiety to conceal the joints which divide the various pieces of highly colored woods introduced into the design. Indeed, the French critic of marquetry in these days makes this jointing the test for good or bad work, and were a panel of intarsia submitted to his judgment in which the mark of a saw could be seen, the work would be at once condemned as bad, though it exhibited all the finer qualities of design and cutting.

The experience of the writer is that the joinings of the various kinds of wood used in a design should not only not be concealed, but that they should be dealt with as frankly as possible, and that their utilization in the design contributes almost more than anything else toward giving the work its character as intarsia or marquetry. It is true that the arrangement of the various pieces of veneer in a manner which will make the work of the cutter practicable and easy and secure an artistic line for the joinings at the same time calls for the exercise of some ingenuity, but this, though irksome and troublesome at first, soon becomes a habit with the designer for intarsia, or at least soon would do so if he understood its value. In nearly every example of modern work in which shading (generally produced by hot sand) has been resorted to, it has been abused.

If the wood be properly selected, shading is rarely necessary, and if it is done at all, it should be done by an artist. It can never be safely left to a merely mechanical cutter of marquetry, even though he works from the most carefully finished drawings. In the hands of an artist, very beautiful effects may be obtained by this process, the same kind of wood being made to yield quite a number of varying shades of color of a low but rich tone, and that without any sacrifice of what, for lack of a better term, I must call the transparent quality, so characteristic of all good marquetry work. Overstaining and the abuse of shading is destructive of this, one of the most valuable and distinctive qualities in inlays of wood.

Ivory has always been a favorite material with workers in tarsia, and in the hands of an experienced designer very charming things may be done with it. There is, however, no material suitable for tarsia which requires so much care and experience in its use. It is ineffective in light colored woods, and in the darker ordinary woods, such as ebony, stained mahogany or rosewood, under polish, the contrast of color is so great that the ivory must be used very sparingly, in other words, the designer must invent for his panels or border a pattern or design which while containing very few elements shall convey the idea of a satisfactory furnishing or filling (always a difficult problem for the designer to solve in any material). In work intended for many other processes and materials, every artist has, at times, to consider the advisability of some such treatment as this, but it is seldom that he finds it so absolutely indispensable to the success of his work as in the application of design to the inlay of ivory for furniture. This kind of work is improved very much by age (the effect of light chiefly), even under polish. The ivory is sometimes stained, in order to bring its color more into harmony with a dark wood ground, but it is never quite satisfactory, and no one who had seen much old ivory intarsia could be deceived by it.

There are conditions possible where, particularly in the decoration of furniture, the advantages are nearly all on the side of intarsia, as compared with carving or modeling. The amount of time wasted, for instance, on very small carvings in dark colored woods intended to be used in furniture is incredible. The color of wood such as mahogany, walnut, etc., makes it impossible to see small carved detail in the various and varying conditions of light which usually obtain in a living room, and when, as so frequently happens, rosewood or some other strongly marked wood is used for this purpose, the markings in the wood are so much stronger than the shadows by which the small carved forms are expressed that their effect is destroyed, and the result must always be confusion and waste of time.

Very small detail, especially in carvings, is introduced much more frequently than is necessary in furniture, as in architecture, and its introduction may usually be taken as indicative of some confusion in the mind of the designer or architect between smallness and delicacy. This idea, that scale or minuteness of detail must somehow be related to refinement or delicacy, absurd as it would appear to be to an artist, must really be very common to the designers of houses and furniture, or we should not see so much skillful labor and valuable time wasted in such useless productions. In this, as in other matters, it is only the thought or design in the thing which really counts; no amount of mere slavish though skillful labor undirected can possibly result in anything but disappointment, and there must be a very plentiful lack of direction in some of the places where modern furniture is decorated. If small carved details must be introduced into the external decoration of furniture, they can only be certainly effective when plain and light-colored wood is used, such as box, pear tree, etc., or quite black wood, such as ebony (which has generally to be made black artificially), materials which have but little marking to disturb the surfaces and lines of the carving.

Undoubtedly the color of these would render them in many cases unsuitable for the decoration of furniture, as they are apt to prove disturbing to the quiet color effect generally associated with a living-room.

It is here that inlay for the surface decorations can be made so useful in the solution of a difficult problem, when it is done with judgment and taste. However quiet it may be kept in tone, and in good hands it is always quiet; however rich and varied in color, it can always be seen, as it does not depend on the light for its due effect, either in the same degree or in the same manner in which carving depends on it. I am not making general comparison between the advantages severally of carving and marquetry for the purposes of decoration, nor do I wish it to be for a moment supposed that I think marquetry can ever supersede carving for general purposes, even if the thing were desirable.

This is merely a protest against the grievous waste of time and of skillful and frequently artistic labor caused by architects and designers through their inability to grasp beforehand the idea of the modifications which will be brought about in the effect of their work by the conditions under which it will be seen. The decoration on small pilasters and capitals as applied to furniture and carved in these woods is rarely seen at all, except on a rough and disturbed surface. Still more rarely can enough of the motive or details be made out to awaken any interest in it.

Assuming that about the same quantity of detail is introduced (which is usually the case), the carving on a pilaster 3′ × 9″ can be done as quickly and at no more—probably less—cost than the same design 1′ 6″ × 4½″, namely, half the size. There is no delicacy or refinement in this relation.

The inferior carver will inevitably give you a coarse and clumsy rendering of the small design, if you trust him with it. From an artist you will just as surely get a suggestion of refinement and delicacy pervading all the work in the large panel, though each man works from the same drawing or even the same model. Moreover, in the larger carving one is much more independent of the markings in the wood, by reason of the fact that the sinkings and shadows are deeper and stronger, and so, in a measure, control the disturbing color.

Apart from the question of cost, which is always in favor of tarsia, there is this essential difference between the two methods, that, while carving must always depend in a large measure on the direction of the light for its effect as carving (you can destroy the effect of carving which is in low relief at any time by a direct front light), the use of inlay makes the direction from which the light enters the room a matter of no moment, so long as the light reaches the object decorated.

I cannot close this paper without some reference to the practice so prevalent among writers on art, and especially applied art, of comparing the conditions under which the work was produced two or three hundred years past with the conditions which obtain in our time. By no conceivable combination of circumstances can we ever get back to the conditions under which those workers produced their work, and although the productions of the writers above mentioned are frequently pleasant reading they are rarely helpful, and indeed we as artists or craftsmen have but little concern with them—we must accept matters as we find

them and do our best under the changed conditions. Moreover, it is so easy to write in that way. The contrasts between the prevailing conditions and those of the past are so sharp, the change so complete, that a writer in this kind, possessed of only very ordinary ability, can hardly fail to be at least picturesque. We are so frequently told by poetical writers on art that a designer should, wherever practicable, carry out his design himself in the material for which it is intended. No artist who has a design in which a really fine idea is embodied need be told this; he would probably be but too glad of the opportunity to do this, assuming that he had ever had the chance to obtain the requisite knowledge and skill in craftsmanship. His ideas are the children of his mind, born not without travail, and when it becomes necessary to hand them over to strangers for their material development, he does not part from them without a pang.

The modern designer, though he be really a master of his own branch of art in all its details, must needs leave a good many of those details to other and more mechanical hands.

STREAM MEASURING IN THE UNITED STATES.*

By F. H. NEWELL.

A STUDY of the water resources of the United States has been carried on consecutively for ten years, bringing together data for scientific and industrial application concerning the distribution and the fluctuation of waters, both surface and underground. Previous to 1888 matters of this kind were frequently the subject of special inquiry in connection with topographic or geologic surveying, but it was not until the authority was specifically conferred by the acts of March 20 and October 2, 1888, that the subject became one of separate and continuous inquiry.

Beginning with the organization of the work during the winter of 1888-89, and the operations of the succeeding field season, the work has been continued under the same general plan and under direction of a single individual until the methods, tentative at first, have attained to something of the established routine essential to rapidity and economy of execution. The continuity of purpose through a decade has enabled the accomplishment of results through moderate expenditures which would have been impossible of attainment by larger sums administered with less consistent purpose.

The attempt is made to obtain data concerning the flow of streams in all parts of the United States. It is, of course, impossible with moderate means to measure all the rivers, and therefore choice must be made of those where the best results can be had with the least outlay of time and money. The measurement of the surface flow is, however, only one part of the problem, for the questions pertaining to the underground supplies are often as important as those concerning the visible waters. A survey of the waters beneath the surface offers even more obstacles, and while it is possible to adopt a general geographic arrangement for the discussion of data concerning surface flows, it is not so easy to do so with the underground waters, as the distribution of these is modified by many geologic conditions. Thus it has been found desirable to treat the discussion of the surface supply by itself, incorporating in a somewhat arbitrary geographic arrangement all of the data available, and to supplement this by the individual and somewhat disconnected papers regarding the waters reached by wells in various areas or States.

In the operations of obtaining the figures relating to the discharge of a stream there are two classes of facts required. The first is the statement of what has been done at each locality and the measurements made. From these original observations there is then obtained by office work a second set of data, based on the first, but giving in more or less concise form the probable flow day by day. The facts first mentioned—those resulting from field work—can, of course, be stated immediately after the operations are performed. The resulting computations, however, usually require for accuracy the digestion of the field notes obtained through one or more seasons, and, to be clearly shown, necessitate the preparation of diagrams. From this condition it has been found desirable in the statement of results to make what might be considered double publication. In the first is given briefly and as soon as possible after the close of the calendar year a statement of the field operations and the immediate results of measurements. In the case of the year 1897 these data have been printed as Water Supply and Irrigation Papers, Nos. 15 and 16. These give a description of each locality at which stream measurements were made, together with the details of bench marks, initial points, character of channel, current meter measurements, and the record of average height of water day by day. These facts are thus made at once available for the use of hydrographers and other persons concerned with the minor points of method and of the character of the work.

While the data above described are being printed, the computations of final results are carried on and diagrams prepared. These form the substance of the present paper. The estimates of daily discharge are not given, being too bulky even for a volume of this description. They may easily be recomputed, however, from the figures given in Water Supply and Irrigation Papers, Nos. 15 and 16, or may be had from the permanent records of the division of hydrography. The results are given numerically by months, the daily changes being graphically expressed in the accompanying diagrams. With these facts is given a brief description of the river or drainage basin, and there is also inserted, wherever obtainable, additional information bearing upon the utilization of the water or the prospect of its future employment for industrial purposes.

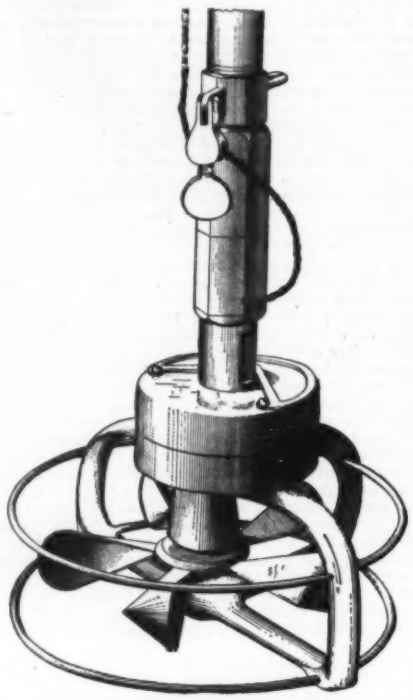


FIG. 1.—THE BAILEY METER, ONE OF THE EARLIER FORMS OF DIRECT-READING METERS.

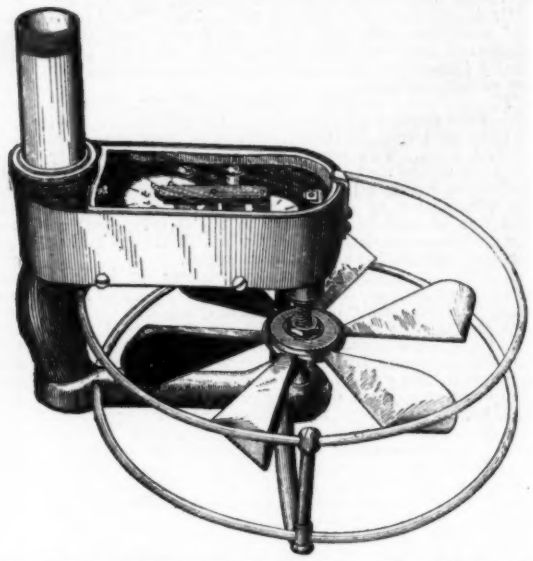


FIG. 2.—THE LALLIE METER, AN IMPROVED FORM OF DIRECT-READING METER. (One-half natural size.)

METHODS.

The methods in use have been previously described in the Fourteenth Annual Report, Part II., on pages 96 to 100, and in the Eleventh Annual Report, Part II., on pages 6 to 10. The computations are based almost wholly on measurements of area of cross section and on figures of velocity obtained by use of some one of the many forms of current meter. In all of these forms of meter the water, striking against the cups or vanes of a wheel, causes it to revolve with a speed which has been found to bear a definite relation to the rate of movement of the particular part of the stream in which it is immersed. This relation is ascertained previously for each instrument by causing it to advance at various speeds through still water. It is assumed that the pushing of the meter through a body of water not in motion gives a rating which can be applied when the meter is held firmly against an advancing current.

The various forms of meter are shown by the accompanying plates and figures, several of these being reproduced from earlier reports. As most of these meters are on the market as commercial articles, it is hardly proper to discuss their relative merits; but it is sufficient to say that most of the hydrographers employed by the Survey or acting in co-operation with it prefer the form shown in Pl. IV.

This preference is not necessarily a guaranty of special merit, but may be dependent largely upon ease of handling and of securing prompt repairs or alterations by the maker when needed for particular purposes.

The purposes of the investigation have to a large extent confined the measurements to the use of instruments of this description. It is not necessary to limit the operations to a designated point, for, there being many times as many streams and localities where results are desired as there are funds to carry on the work, it is possible to choose the places where the conditions are most favorable; on the other hand, it is not practicable to incur considerable expense to secure artificially good conditions, and therefore search must be made for a spot naturally favorable. The attempt is made, therefore, to find a place on the stream to be measured where the bed and banks are comparatively stable and where the current is neither sluggish nor extremely swift.

If the streams were mainly small—such, for example, as would be sufficient for the water supply of a large city—it might be practicable and desirable to erect a weir or short rating flume, but with the great variation in height of water and velocity on most of the important streams of the country, this is out of the question. On the other hand, the various empirical formulæ based upon experimental data have not been considered practicable, as the streams vary so greatly, and the element of personal opinion or judgment as to the choice of some one or more constants affects the results widely. An illustration of a locality where a weir has been effectively used is that noted on Plate I., *A*, erected in the Portage gorge of Genesee River and described in the report of the State engineer and surveyor of New York.

The use of floats is often resorted to in the miscellaneous measurements made during a general reconnaissance along a stream. In cases of this kind, where no permanent bench marks have been established, and therefore there is no means of determining the exact height of water, the comparatively rough approximation by means of floats is amply sufficient for all prac-

* Being the Introduction of the Report of Progress of Stream Measurements for the Calendar Year of 1897, including papers by Dwight Porter, J. B. Lippincott, and other hydrographers. Forming part of the Nineteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1897-98. Reprinted from Part IV. Hydrography. F. H. Newell, Chief of the division. Reprinted by permission of the Director of the United States Geological Survey, Hon. Charles D. Walcott.

PLATE I.—*A*. MEASURING WEIR IN GENESEE RIVER NEAR PORTAGE, NEW YORK.

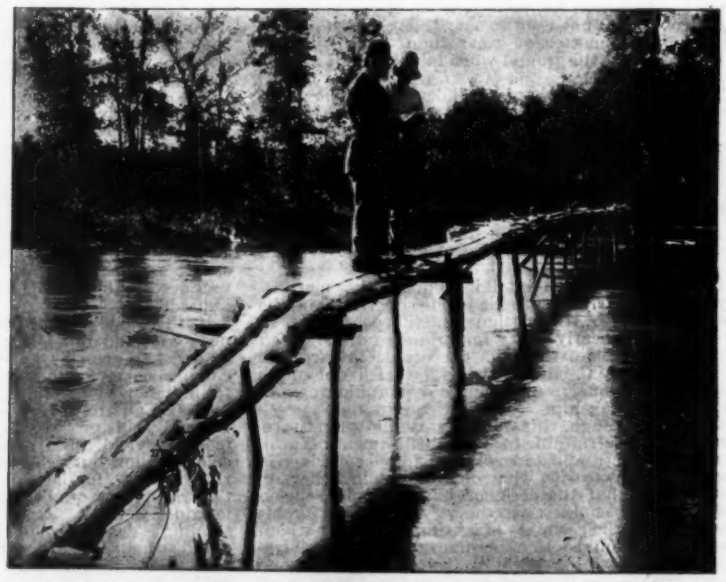


PLATE I.—*B*. MEASURING FROM TEMPORARY BRIDGE, GULL RIVER, MINNESOTA.

tical purposes. A rise or fall in the surface of an inch or two causes a change of discharge well within the accuracy of float measurements. For this purpose a course is chosen where the stream is nearly straight and is flowing with a comparatively uniform velocity, without sudden rapids and stretches of still water. Here a space of 100 to 300 feet is laid off as near as possible to the edge of the water, and range poles are stuck into the ground, two at each end of the measured distance. They may be both on one bank, or in the case of narrow streams on opposite sides, and are so arranged that in looking across each of the pair the line of sight passes as nearly as possible at right angles to the general current of flow. The width of the stream must be ascertained by direct measurement or by simple triangulation, and the depth by sounding. This is usually done at the upper end, middle, and lower end of the course, and the average taken to obtain the area of cross section. Floats are then placed in the water, and the number of seconds they require to pass from the upper to the lower range poles is noted. For small streams these are usually sticks or chips which can be easily seen. It is possible for one man to perform the entire operation. He goes above the upper range poles and tosses a chip into the middle or side of the stream; then going down to the first set of range poles he notes the time of passage of the line of sight, and then going down to the lower end, obtains the number of seconds required for the chip to reach the second line of sight. The average velocity of the stream is usually assumed to be about eight-tenths of the average surface velocity. This operation is susceptible of great refinement; for example, by employing a number of men and by making submerged floats or loading short sticks so that they will stand nearly upright, the lower end just clearing the bed of the river and the upper end appearing above the surface. This involves, however, an equipment and expenditure of time which is not usually possible on reconnaissance measurements, and for great accuracy necessitates conditions which are seldom found to exist.

In using current meters, the first consideration is that of getting to the water. In the case of a shallow stream, it is practicable to wade out into it and hold the meter in position. In cold weather this is made possible by wearing various forms of rubber boots or fisherman's waders. It is, however, a clumsy operation at best, and can not be resorted to in time of flood. For larger streams the first thought is a boat. This must be held in position by anchoring successively at points across the stream, or, better, by attachment by sliding pulley to a cable suspended above the water, as shown in Pl. III., *B*. In the case of measurements made at intervals of weeks or months, it is usually impossible to maintain a boat in good condition, and in high floods a boat held in position is dangerous. For these reasons recourse is had as often as possible to some device suspended above and clear of the water, leading to the development of the suspended box or car, which, running backward and forward across the river upon a cable, can be placed in any desired position and raised or lowered.

At the selected point on the river supports and anchorage for a cable are prepared on each bank. The anchorage usually consists of logs or timbers buried deeply in the soil, the ends of the cable being securely wrapped around these and being held from slipping by suitable clamps. Between the anchorage and the river a stout piece of timber or shears is erected to a height sufficient to hold the cable above the surface of high water after allowing for a moderate amount of drop at the center. Wherever possible, a stout tree is used for supporting one or both ends of the cable, or solid stumps are utilized for anchorage. At one end the cable is held by means of a strong turn-buckle, allowing any stretch to be taken up. The cables employed are usually from five-eighths to three-fourths of an inch in diameter, and are of the kind known as "standing," as distinguished from the more flexible wire ropes used in hoisting. This cable is used in spans up to 500 feet or more in length. On the cable are fastened two ordinary pulley blocks, from which is suspended a stout box about 3 feet square or of larger dimensions, according to the individual wishes of the hydrographer (see Pl. II., *A*). A stout half barrel is sometimes used, or in some cases a long box, in which two men may be seated comfortably, as shown in Pl. II., *B*. This can be pulled from one side of the river to the other by reaching up and grasping the cable overhead or by a line running from the pulleys to each shore and passing over other pulleys, the ends being brought back to the car. In some cases, where there is considerable drop in the center of the cable, the cars are raised and lowered by means of tackle on each side (see Pl. V.) Sitting in the car, the hydrographer moves from point to point, sounds the depth of the water, and obtains the velocity by means of the current meter.

Wherever it happens that bridges are available, these are employed, but it is often the case that the piers of the bridge obstruct the flow or the foundations catch driftwood, resulting in complications which render it impossible to make accurate measurements either of depth or velocity. Wherever a good, clear span can be had, it is usually possible to make measurements with considerable accuracy and with rapidity and comfort (see Pl. III., *A*). Sometimes it is possible to erect on small, shallow streams a temporary bridge like that shown in Pl. I., *B*.

The method of holding the meter or supporting it at a given point in the stream is dependent largely on the facility for getting near the surface of the water. In the case of wading or of using the meter from a low bridge, the meter is usually fastened on the end of a pole or metal rod, as shown in Pls. II. and V. When the hydrographer works from a high bridge or from a car hung at some distance above the water, it is usually necessary to suspend the meter from a cord or rope of some kind. When the water is not too swift, the suspending material consists merely of the double conducting insulated wire, which serves at the same time to make electric connection between the meter and the recording or sounding devices in the hands of the hydrographer. The ordinary cotton-covered incandescent light cord is used for this purpose, it being found that the cotton covering does not wear so rapidly as silk covering.

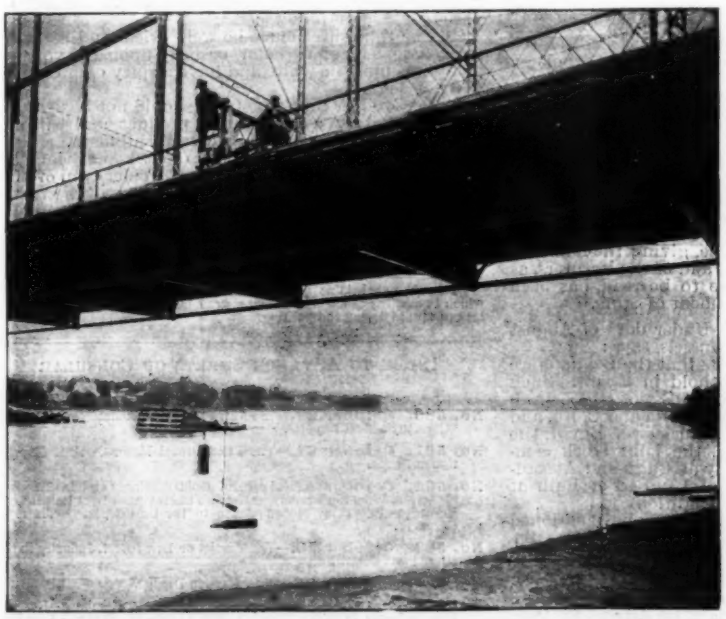
For convenience of computation of the results, the space across the channel of the stream is divided into short distances of known length, usually 10 or 20 feet. In case of a bridge, these are indicated by making

A.

B.

PLATE II.—CARS USED IN MEASURING VELOCITY OF RIVER WATER.

A, Shenandoah River, near Millville, West Virginia; *B*, Arkansas River at Canyon, Colorado.



A.

B.

PLATE III.—MEASURING VELOCITY OF WATER IN MISSISSIPPI RIVER.

A, from bridge at Anoka, Minnesota, in August, 1897 (Ellis meter); *B*, above mouth of Crow Wing River, Minnesota, in September, 1896.

suitable permanent marks, inconspicuous if necessary, on the railing or floor beams. Where the work is done from a boat or suspended car, it is customary to place a tagged wire a short distance above the cable and parallel with it. For this purpose the ordinary twisted barbed fence wire has been found most desirable, as the tags can be fastened firmly so that they can not slip from side to side, and barbed wire is less likely to be stolen than the ordinary smooth form. The difficulty in putting this up is usually more than compensated by its permanence. The tags used consist of small pieces of metal 3 to 4 inches in width, usually deeply notched or cut in such conspicuous forms as to give at a glance the distance from the initial point. This latter is usually some easily identified object on shore, such as a stone monument, a permanent stump, or a bridge pier. Soundings are made at each tag, and at intermediate intervals, if necessary, the depth being measured by a pulley or by a small stout line provided with a lead sinker. Velocities may be observed at each tag, or at every second or third in case of uniform cross section.

(To be continued.)

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Trade Competition with Great Britain.—Under date of August 18, 1899, Consul Marshal Halstead, of Birmingham, says that a strong feeling exists in England over the orders given for American locomotives for use on English railroads. He warns American builders that an effort will be made to find the locomotives inferior to British-built engines, and adds:

The railroad managers who have purchased American locomotives have been under a continuous fire of questions, and it is hardly worth while to add fuel to the flames by boasting that "prices will settle future locomotive orders in America's favor." Why not permit the answer of the railroad managers—that the purchases were made because British shops were too busy to take further orders—to have its soothing influence? The matter of price, or of efficiency, if a change in construction is required, counts for less here than in the United States.

There is a good deal that is protective in this attitude on the part of the British public, in questioning those who dare to buy abroad articles which might be made here. The Atbara bridge contract, the Birmingham Post says, promises to become "a classical instance of the kind of competition in which English firms have been apt to get the worst recently;" it promises also to be a classical instance of a protest, because British officials in Egypt purchased where they could get the article quickest. The Birmingham Post says:

"That the English makers were hopelessly underbid with regard to price has been before explained, but it appears that the principal and, indeed, the sole determining factor was the time of delivery."

The earliest English offer was six months; the Americans accomplished the work, despite a week's delay because of the great snowstorm of last winter, in forty-two days. Parliamentary inquiries were instituted by Sir Alfred Hickman last April with regard to the circumstances under which the contract for the bridge had been given to an American firm, which inquiry has resulted in a full report on the matter by Lord Cromer. An exactly similar case, though with smaller value, has come to my knowledge through the declarations before me, as consul, of apparatus purchased here by the United States War Department for use in Cuban lighthouses. I have heard of no protest from the United States.

Mr. Halstead sends a printed account of the history of the Atbara bridge contract, which is not given, as it has already appeared in American newspapers.

On September 5, 1899, Mr. Halstead writes further: Under the headlines "Tried and found wanting" and "No repeat orders," The Ironmonger says:

"The American locomotives which have been delivered to the Midland Railway Company are naturally being subjected to some very keen criticism by English engineers. The representative of one well-known locomotive building firm in this country gave me the other day quite a long list of their alleged defects, one of the gravest being the state of the boilers, which are said to leak so badly as to leave a distinct track along the ballast wherever they go. The engines are nothing like so strong as English makes; they are very roughly finished throughout, and when the parts arrived in this country it took the workmen as long to put them together as an English firm would require to build the entire machine.

. . . . . .

"The comments of English engineering experts who have examined the American locomotives are by no means flattering, and it is confidently asserted that when (in the not far-off future) the engines have to be sent to the repairing shop, the verdict on their construction will be so unfavorable as to bar the placing of further orders. That this opinion is not due to mere insular prejudice on the part of the makers in this country will be conceded when I mention that two French engineers who inspected the Yankee locomotives at Derby fully confirm the conclusions arrived at as to the inferiority of the imported machines to those of British make, alike in point of strength of construction and general excellence of workmanship."

The London Daily Mail to-day quotes Mr. C. Rous-Marten as saying that Mr. Johnson, the mechanical engineer in chief of the Midland line, informed him that:

"As soon as all the American engines were erected, they would be placed on regular duty in comparison with a like number of British-built engines of approximately equal power, and, after a certain period, the results would be fairly and impartially compared."

Mr. Rous-Marten credits Mr. H. A. Ivatt, locomotive superintendent of the Great Northern Railway, with saying:

"I have been examining them, and I cannot find any important part that ought not, with fair usage, to last as long, or nearly so, as those of our own engines."

Freight Facilities from Atlantic Ports to China.—Consul-General Goodnow, of Shanghai, on July 22, 1899, transmits a letter from a Shanghai firm, taking issue with the statement in an American trade journal that trade is hindered by the lack of transportation facilities between the Atlantic seaboard and China, and that freights are frequently forced to go via Europe, in spite of higher rates, through the action of a combination of steamship companies and shipping brokers. The letter claims that ample facilities now exist for the shipment of cargo from New York to China and Japan via Suez, and quotes rates of freight as varying from 22s. 6d. to 27s. 6d. ($5.46 to $6.68) per ton of 40 cubic feet, against 45s. to 50s. ($10.93 to $12.15), charged by steamship owners from London and Liverpool to same destination. Daily customs returns, it says, show that nine steamers from New York have discharged at Shanghai 21,500 tons measurement of cargo during the six months ended June 30, 1899. Although a considerable portion of the more valuable cargo destined for the Eastern States is shipped via the Pacific coast and railroads, no fancy rates are charged by the Pacific lines, and tea can be shipped to-day via San Francisco and reach New York in about thirty-five days for the equivalent of 40s. ($9.72) per ton of 40 cubic feet; while the rate charged by Suez steamers, occupying sixty to seventy days on the voyage, is 27s. 6d. ($6.68). The letter concludes:

"We venture to say that during the past three years no shipments to New York of any importance have been made via Europe. In former years, shippers of tea sometimes used that route in order to have the option of offering their produce in both markets; but as at present the rate to New York via London or Hamburg is 55s. ($13.36) against 26s. 6d. ($6.43) direct, no merchant in his right mind would ship by the indirect route."

British-German Trade.—Sir Charles Oppenheimer, the British consul-general in Frankfort, in his annual commercial report for 1898, just published, shows that the British exports to Germany are growing in a greater degree than German exports to Great Britain. Richard Guenther, consul-general at Frankfort, says:

The increase of British exports to Germany is especially noticeable in cotton and cotton manufactures, and also in iron and its products.

In leather and leather goods, the year 1898 was the best for British trade in Germany since 1889, as also in manufactures of linen. With reference to preserves and sauces, the report says that in spite of their undeniable excellence, they are too strongly seasoned for the German palate. The sales of these latter goods could be increased, the consul-general says, if more attention were paid to the German taste; but, on the whole, he is of the opinion that British exporters have reason to be satisfied with their position in the German market. British goods, he says, are constantly gaining in favor among German consumers, on account of their solidity and excellence of material and the attention paid to modern taste. England could take the position in the German market, with reference to sporting goods, articles "de luxe," furniture, and many household supplies, which France used to occupy. He calls attention to the fact that German manufacturers are taking pains to place their goods on the market in the English style. German exports to England have decreased in preserves, drugs, flax, copper, wearing apparel, and paper and silk, and increased in cotton, wool, manufactures of iron, and instruments.

More than one-fifth of the total of German exports goes to Great Britain and her colonies. Germany's commerce with Canada in 1898 amounted to 20,900,000 marks ($4,974,000), 16,700,000 marks ($3,974,000) in exports and 4,200,000 marks ($1,000,000) in imports. The principal articles imported from Canada are asbestos, cobalt and nickel ores, and fruits. Germany sells to Canada mostly sugar and wearing apparel.

Congress of Medicine in Paris.—The department has received from the French embassy, under date of Washington, August 3, 1899, programme of the international congress of medicine, to be held at Paris from August 2 to 9, 1900. Delegates from the United States are invited. Doctors of medicine or scientists presented by the French or foreign national committees will be accepted as members. Admission cards for members cost 25 francs ($4.82). French will be the official language, but German, English, or French may be used at the general meetings. Suggestions relating to the labors of the congress should be communicated to the executive committee before May 1, 1900. The sections of the congress are as follows: (1) Biological sciences—descriptive and comparative anatomy, histology, embryology and teratology, physiology, biological natural philosophy, and chemistry; (2) medical sciences—general pathology and experimental pathology, bacteriology, parasitology, pathological anatomy, internal pathology, hygiene and medical pathology of children, therapeutics and pharmacology, neurology, psychiatry, dermatology, and syphiligraphy; (3) surgical sciences—general surgery, surgery in the case of children, urinary surgery, ophthalmology, laryngology, rhinology, otology, stomatology; (4) obstetrics and gynecology; (5) public medicine—legal medicine, military medicine and surgery, naval medicine, colonial medicine.

The full text of the programme, giving the names of the foreign national committees and of the lecturers, as well as the titles of the papers to be read, has been filed for reference in the Department of State.

Belgian Enterprise in Egypt.—Under date of August 22, 1899, Consul Roosevelt, of Brussels, says:

From recent reports, it appears that the Belgians are getting a firm commercial foothold in Egypt. Such enterprises as the railway of Lower Egypt (Mansourah and Menzaleh), tramways of Alexandria and Cairo, and the Industrial and Agricultural Society of Egypt, the Crown Brewery at Alexandria, the joint stock company, Rolin Padova & Company at Cairo and Alexandria, and the importing house of Lambert et Ralli at Alexandria are in a prosperous condition.

Among others that are thriving may be mentioned the Sleeping Car Company conducting a service between Cairo and Luxor, and the Société Anonyme des Grands-Hotels.

Excessive Freight Charges to Great Britain.—Consul Marshal Halstead, of Birmingham, on August 23, 1899, sends copies of recent correspondence between himself and the freight bureau of the National Association of Manufacturers. It appears that a Birmingham merchant was forced to pay, on a shipment of goods from Minneapolis, valued at $9.30, £2 19s. ($14.35) freight charges; in other words, the Minneapolis concern, says the consul, evidently knew nothing about freight shipments and simply sent the goods through without inquiring as to charges, and the steamship line took advantage of the opportunity and made the excessive charge of £2 2s. ($10.20) to carry the goods across the ocean. Mr. Halstead wrote to the National Association in regard to the matter, and their reply says, in part:

"This particular case only shows how little our manufacturers realize the importance, in opening foreign trade, of availing themselves of the proper facilities for getting their goods to destination.

"Had this shipment passed through our hands, we would probably have delivered the goods from Minneapolis to Birmingham under contracts at not over $4.50, possibly $5, and perhaps for very much less. A recent report of the association shows a net saving of over 13 per cent. upon all shipments made by it."

New Use for American Dried Apples in France.—It is a curious fact that the consumption of wine in France is steadily diminishing, says A. W. Tourgee, consul at Bordeaux. This results from a variety of causes, prominent among which is a general belief among the common people that the product of the vine is apt to be deleteriously adulterated. Whether this is true or not, it is a matter of such universal comment that they naturally make it an excuse for discarding wine and indulging in a beverage which they declare is too cheap for anybody to dream of adulterating. Their first resort was to the product of the apple and pear orchards of Normandy and Brittany. In 1895, the consumption of cider in Paris amounted to 10,000,000 gallons, but in consequence of the bad apple harvests of 1896 and 1897, this fell in 1898 to an utterly insignificant figure.

The importation of cider to meet the demand was impossible, because of the prohibitive duties of 8·50 francs per hektoliter, amounting with the octroi duty to about 16 cents a gallon in Paris. Of course, no man could pay a tax of 4 cents a quart and furnish a drink cheap enough to meet the demand for cider, which could not be diluted to any extent with water and retain its peculiar "tang." It became necessary, therefore, to find a substitute.

With the English or American taste, this substitute would probably have been found in a sort of beer or some mere alcoholic product. But the Frenchman, if he is not addicted to absinthe, usually cares little for the alcoholic character of his favorite tipple. What he wants is, not to become intoxicated, but to have a pleasant drink which he can sip by the hour in company with his friends at the buvette. Two things are essential—first, it must have a pleasant, fruity flavor (if a little piquant, so much the better); and, second, it must not make too heavy a drain upon his purse. The bourgeois rarely allows his palate to make him forget his pocket. Cheapness and briskness are essential elements of a popular drink for the French people.

Out of these conditions, aided by the genius of some unknown mixer of drinks in Paris, was evolved "piquette," a sparkling, fruity beverage, composed of dried apples, raisins, and water, allowed to stand until fermentation takes place and then bottled, with the addition of a little sugar, or served directly from the cask. Two cents a glass is the ordinary charge at the buvette for this spicy and, as a rule, harmless beverage. A franc (20 cents) will furnish a man a "treat" which is good for a two hours' sitting at the buvette, but hardly develops enough alcoholic influence to perceptibly reduce the ordinary liveliness of the tongue.

The following is the receipt given me for its preparation by one of the leading manufacturers of Bordeaux:

PIQUETTE.—Five pounds of raisins, 5 pounds of dried apples, and 5 gallons of water. Put in an open cask and let stand for three days; bottle with a half teaspoonful of sugar and a bit of cinnamon in each bottle. Vary the flavor to suit the taste.

It is really a pleasant summer beverage, and if made in the United States, might take the place of some of our mysterious decoctions with decided advantage to health.

The special American interest in piquette, however, is found at present in the fact that dried apples out of which it is made are imported from the United States.* In 1898, 50,000,000 gallons of this piquant beverage were consumed in France, against 35,000,000 in 1897. The dried apples used in its manufacture are the lowest grade of windfalls—sliced, including skins, cores, and "inhabitants," without distinction as to quality or variety, except as follows:

(1) The thin slices must be well dried and securely packed, so as not to color or heat upon the voyage. The slices must be white and have a spicy odor or they will not sell.

(2) Decayed or over-ripe fruit should not be used, as it gives too dark a color to the product and will not bring a price sufficient to pay cost of shipment.

The consumption of this beverage is rapidly increasing in France, and it is said that the cider crop of this year is likely to be so short as to create an even greater demand for it. Made of carefully assorted fruit, it should be a valuable addition to our household drinks, since but little need be made at a time, and it is both piquant and practically innocuous.

* I would note in this connection that of 500 barrels of dried apples which I recently examined, 200 were a dead loss to the shipper, because of lack of care in drying and packing.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 560. October 23.—*Southern Brazil—*Commerce of Italy—*Germany's Meat Imports.

No. 561. October 24.—The International Motor-Carriage Exposition at Berlin.

No. 562. October 25.—Lease of Gold-Bearing Land in Siberia—Sheep and Wool in Germany—*Matches in Mexico—Street Railways in Veracruz—Export of Mocha Coffee to the United States—Trusts in Germany.

No. 563. October 26.—The Tasajo, or Dried-Beef, Industry in the River Plata Countries.

No. 564. October 27.—New Russian Dredge.

No. 565. October 28.—Export of Malt from Hamburg—Russia's Hop Industry in 1898—*Plan to Sell Goods in Europe—American Apples in Germany—The Grain Situation in France.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Perfumed Vaseline Pomade.—Unite 250 grammes of freshly rendered lard and 25 grammes of white wax at moderate heat and mix well with 200 grammes of vaseline. Now add 15 grammes of bergamot oil, 3 grammes of lavender oil, 2 grammes of geranium oil and 2 grammes of lemon oil, mixing well.—Neueste Erf. und Erf.

To Cool Drinks Without Ice.—Wrap the bottle in a cloth, previously dipped in cold water and well wrung out. Next put the bottle in a vessel half filled with cold water, place the whole on the sill of an open window and cause a draught of air by opening the door for some time. The evaporation taking place in the wet cloth produces a considerable cooling, which is imparted to the contents of the flask.—Zeitschrift für Krankenpflege.

Resin Sticks, or, as their inventor, Unna, calls them, Stili resinosi, are intended for the removal of hairs and are made from colophony with an admixture of 10 per cent. of yellow wax. The sticks are heated like a stick of sealing wax until soft or semi-liquid (61°-62° C.) and lightly applied on the place from which the hair is to be removed, and the mass is allowed to cool. These resin sticks are said to give good satisfaction.—Monatshefte f. prakt. Dermatologie.

To Clean Articles of Marble or Alabaster.—In a comparatively spacious tub place a somewhat taller vessel upside down. On this set the article to be cleaned, so that it is not standing in the water, whereby the cemented parts would be loosened. Into this tub pour a few inches of cold water—hot water renders marble dull—take a soft brush and a piece of Venetian soap, dip the former in the water and rub on the latter carefully, brushing off the article from top to bottom. When in this manner dust and dirt have been dissolved, sprinkle off all soap particles by means of a watering pot and cold water and dab the object with a clean sponge which absorbs the moisture, place it upon a cloth and carefully dry off with a very clean soft cloth, rubbing gently. This treatment will restore the former gloss to the marble.—Antiquitaeten Zeitung.

Imitation of Frosted Glass.—According to the Ill. Fachblatt f. d. g. Glas-, Porzellan- u. St. Industrie, frosted glass may be readily imitated by a suitable coating applied to the glass pane, and may be used for various purposes. White lead ground in a mixture of three-fourths varnish and one-fourth oil of turpentine is employed, to which burnt white vitriol and white sugar of lead are added for drier. The paint must be prepared exceedingly thin and applied to the glass as evenly as possible, using a broad brush. If the windows require a new coat, the old one is first removed by the use of a strong lye, by potash, or else daub on a mixture of hydrochloric acid 2 grammes, vitriol 2 grammes, copper sulphate 1 gramme, and gum arabic 1 gramme, by means of a brush. The production of this imitation frosting entails little expense and is of special advantage when a temporary use of the glass is desired.

Practical Application of the Roentgen Rays on Metallic Alloys.—In a highly interesting manner the application of the Roentgen rays on metallic alloys has shown their behavior to be similar to that of the frequently examined solutions.

We know that salt solutions, according to their concentration, yield different products on freezing. In the case of diluted solutions, ice crystals will first fall down until the solution has become sufficiently concentrated, so that finally the whole solution solidifies at a certain temperature. On the other hand, the salt crystals are first precipitated from a warm concentrated solution until the concentration is reached, and the further behavior is similar to that of the first case. The solidified alloys exhibit similar results. Heycock and Neville have examined a number of alloys of metals, of which one is pervious, the other impervious, to the Roentgen rays, after slow cooling from various mixing proportions, by photographing thin disks of the solidified alloy by means of the Roentgen rays. Especially suitable were, owing to the difference in their perviousness, alloys of gold and sodium, gold and aluminum, copper and aluminum and silver and aluminum.

According to the combining proportions of the pervious and impervious components, the deposits of crystals in the mass, which are distinctly visible on the representative photographs, differed. On the whole they correspond with the above behavior of the solution.—Neueste Erfindungen und Erfahrungen.

Valuable New Trees.—Among the many new rare and valuable trees and shrubs which were recommended at last meeting of dendrologists at Dresden, Larix leptolepis, as the most beautiful larch variety, deserves the greatest favor. With its nicely colored needles it takes the place of the cedar of Lebanon.

Much praise was also bestowed upon the winter-proof cherry laurel, Prunus Lauro, Cerasus Schipkaensis. With its large, glossy, evergreen leaves it has, since its introduction, withstood all kinds of weather, and has developed splendidly everywhere.

An elm which, owing to its hard wood, promises to attain a high practical value is the true American elm, Ulmus Americana.

As an avenue tree, the cork tree, Phillodendron amurense, has been found beautiful. It also thrives in dry soil.

An ornamental tree which ought to be cultivated extensively is Cercydiphyllum Japonicum, resembling the Cercis in foliage, growing very readily and very pretty.

Another handsome old German tree which is more and more forgotten, viz., the service tree, Sorbus, was called to mind by Garden Inspector Beissner.

As regards the bird cherry, Faul beerbaum, a new variety, the American bird cherry, Cerasus serotina cartilaginea, with coarse glossy leaves, deserves preference.

Not entirely winter-proof, unfortunately, is the beautifully blooming ornamental shrub, Leycesteria formosa. But, if frozen, it readily sprouts out again and blossoms profusely.

Our parks, etc., are often of a tiresome monotony. Therefore we ought to welcome with pleasure the efforts of the Dendrological Society to continually introduce new and handsome trees and shrubs.—Praktischer Rathgeber im Obst- und Gartenbau.

MISCELLANEOUS NOTES.

The British exports of coal for the first three-quarters of 1899 have been the largest in the history of the trade. With the coal shipped for the use of steamers engaged in the foreign trade, they exceed 40,000,000 tons, being more than four times the total output of coal in the United Kingdom in the first year of the century. The best customer has been France, which has taken close on 5,000,000 tons in the nine months, or more than a million tons in excess of the quantity taken in the corresponding period of 1898. The British exports to Russia also show an advance of more than 1,200,000 tons in excess of those of any previous corresponding period.

Mr. A. A. Hurd, general attorney for the Kansas section of the Atchison, Topeka and Santa Fe Railway Company, has ordered to the Topeka shops of that company, for general repairs, two box cars and one flat car, loaded with lumber. These cars are in miniature of the freight car equipment and are used by the company's attorneys as evidence in damage suits. These models have not only traveled from Topeka to practically every county seat along the line of the Santa Fe in Kansas, but to different points all the way from Chicago to El Paso, Tex. They have been used by the Santa Fe attorneys in illustrating the natures of accidents, and have assisted in saving the Santa Fe company thousands of dollars in damages claimed. These miniature cars are perfect in every detail, but were built before the adoption of the air brake and automatic couplers, and the repairs they are to receive consist in being remodeled and brought up to the latest practice by the addition of air brakes and automatic couplers.

A contribution by Herr Gerstenbrand to the Photographisches Rundschau, and reproduced in the Bullettino della Società Fotografica Italiana, describes a ready method of quickly adjusting the object and the ground glass screen to parallelism; a matter of importance when copying is to be undertaken with ordinary apparatus, not specially fitted for insuring proper adjustment. Against the bottom edge of the board upon which the original is fastened, a magnetic compass is held; this compass being in a square case, or at any rate it must afford two resting places at some distance from each other. The reading having been taken, the compass is similarly placed in relation to the focusing screen, and this latter is shifted until the same reading is obtained. Those who have worked with a prismatic compass for filling in the details of a survey will realize the accuracy obtainable by this very easy and rapid method of working, provided only that the compass is properly mounted, and that nothing magnetic disturbs the result. The horizontal adjustment having been made as described, the plumb line is used to secure the vertical correspondence.

Matches without heads have been much puffed of late on the Continent. Their one advantage is undeniable. As there is no head, there is no cap to fly off from the match in a semi-incandescent state, which remains an objection to some safety matches. But otherwise the headless match would not only appear to be purposeless, but directly dangerous. The sticks are impregnated with chlorate of barium. All barium salts are poisonous, and in this case the whole match would be objectionable, and not only, the phosphorus-bearing head. There are still people left who break or cut off the head of an ordinary match and use the stick as a substitute for a toothpick. That habit is difficult to eradicate, and in the case of the headless match it would be little use to cut off the rounded end to be rubbed. By this rounded end the absent head is to be recognized. The barium chlorate fumes, moreover, are also injurious. We, therefore, do not wish to make the acquaintance of these matches, though they are cheaper than others, and their manufacture is not so directly dangerous as that of the old yellow phosphorus match. That the advocates of the new matches are rather hard up for an argument in favor of their article is shown by the circumstance that they emphasize the absence of paraffin in their matches, as if there were any danger lurking in the burning paraffin.

The London Globe revives the old story to the effect that hundreds of vests of mail are sold annually to officers in the British army. The mail is inclosed in leather casing, which is sewn inside the tunic so as to be invisible unless the garment is picked to pieces. And the same with helmets—a similar device is fixed as lining so as to give additional protection in case of need. Some officers are not above wearing mail vests underneath their tunics, and perfectly oblivious to their comrades, who, although they may scoff in time of peace, would be only too glad to don one themselves when in the middle of hostilities. The majority of mail wearers are officers, because the suits are very expensive, costing about ten guineas each. Some enlisted men are prepared to spend that amount in order to insure themselves to a certain extent against the enemy's spent bullets. Against a modern bullet fired at short distance, of course, these suits of armor are next to useless, although they may be instrumental in turning its course or stopping its penetrating power. During the China-Japanese war of 1895, several hundred suits of armor were sent from London to the Orient, where they were eagerly bought up by the combatants at a heavy price. During the American war of last year, a London trader, says The Globe, did the same thing, but it was not nearly so successful, for he found he had been forestalled by Yankee firms and such officers in the American army as had intended going in for a suit of mail had already obtained them. He then offered his goods to the Spaniards, who proved to be good customers, and were prepared to pay a good price for the luxury. A notable instance is cited by the paper of the value of mail as occurring during the battle of Omdurman last September. One officer got into the thick of the fight, and was slashed on all sides by the Dervishes. His men were surprised to see that he had escaped all the force of the blows, expecting to see him fall from his horse every minute a mass of wounds. After the battle was over, however, he appeared perfectly unscathed save for a few slight wounds on his chest. Then he revealed the suit of mail which covered him and to which he owed his life.

SELECTED FORMULÆ.

Protecting Iron from Rust.—Otto Hering, of Berlin, has lately patented a method for producing basic oils to protect iron from rust. The oil is made to contain in solution certain basic substances. Either the oil (fatty or mineral) may be saturated with ammonia gas at the ordinary temperature, or organic bases can be dissolved in it. In practice a combination of these two plans is advisable, the ammonia gas being put into the oil after the organic bases. An advantage claimed for this new rust protector is that it contains no moisture, and is mixed with bodies able to check any tendency to rust formation at the outset.

Stove Polish.—A correspondent of The Pharmaceutical Era submits the following formula for a preparation which he says his company advertises as a "dustless paste stove polish:"

Animal charcoal	8 parts.
Black lead	8 "
Molasses	4 "
Sulphuric acid	2 "
Hydrochloric acid	1 "
Water, enough to make a paste.	

He says he allows the acids to act on the charcoal and molasses for twenty-four hours, after which the graphite is added with enough water to form a paste. He says that the trouble with this paste is that "it forms a layer on the cloth when applied, and this layer in contact with a warm stove falls as dust to the floor."

Cement for Porcelain Letters.—The National Druggist says, replying to a correspondent who complains that porcelain letters are difficult to keep fastened to glass, that the failure of some cements to hold is due to the difference in the rate of expansion of the glass and porcelain. A cement which that journal recommends as likely to overcome the difficulty is made as follows: Slake fifteen parts of fresh quick-lime in twenty parts of water. Melt fifty parts of caoutchouc and fifty parts of linseed oil varnish together, and bring the mixture to a boil. While boiling, pour the liquid on the slaked lime, little by little, under constant stirring. Pass the mixture, while still hot, through muslin, to remove any possible lumps, and let cool. It takes this cement two days to set completely, but when dry, it makes a joint that will resist a great deal of pulling whether from expansion or contraction, or force acting directly (as a wedge) to pull apart the pieces united with it. By thinning the mixture down with oil of turpentine, a brilliant, powerfully adhesive varnish is obtained.

A New or Improved Igniting Composition for Matches.—Red or amorphous is substituted for yellow phosphorus in match heads. The composition of the igniting paste is given as follows:

Soaked glue (1 to 5 of water)	37·0
Powdered glass	7·5
Whiting	7·5
Amorphous phosphorus (pure)	10·0
Paraffin wax	4·0
Chlorate of potash	27·0
Sugar or lamp black	7·0

Silicate of soda may be substituted for the glue, bichromate of potash added for damp climates, and sulphur for large matches. This forms the subject of an English patent.

Asthma Paper.—

Potassium nitrate	17 grammes.
Extract of stramonium	10 "
Sugar	20 "
Hot water	100 "

Dissolve and impregnate white filter paper with the solution and dry.

Fumigating Paper.—

1.	Musk	0·2 grammes.
	Oil of rose	1·0 "
	Benzoin	100·0 "
	Myrrh	12·0 "
	Orris root	250·0 "
	Alcohol (90 per cent.)	500·0 "
2.	Benzoin	80·0 grammes.
	Balsam tolu,	
	Storax,	
	Sandalwood, of each	20·0 "
	Myrrh	10·0 "
	Cascarilla bark	20·0 "
	Musk	0·2 "
	Alcohol	250·0 "

—Pharmaceutical Era.

To Cure Frost on Show Windows.—During the last winter I made a number of experiments in removing ice or congelation of water from window panes, using fourteen methods. I found them efficacious in every instance, but some far superior to others. That which worked best No. 1, that second best No. 2, and so on. I noted that in shops where there are so-called "box windows," the congealing was most apparent, and that in some where there was a comparatively dry heat, the windows were not materially affected. I place the efficacy of the remedies in the following order: 1, flame of an alcohol lamp; 2, sulphuric acid; 3, aqua ammonia; 4, glycerine; 5, aqua regia; 6, hydrochloric acid; 7, benzine; 8, hydriodic acid; 9, boric acid; 10, alcohol; 11, nitric acid; 12, cobalt nitrate; 13, infusion of nut galls; 14, tincture of ferrous sulphate. I found, adds the correspondent, that by the use of an alcohol lamp (which, of course, has to be handled with great care) the results were immediate, and the effect more nearly permanent than by any other of the experiments. The sulphuric acid application was made with a cotton-cloth swab, care being taken not to allow any dripping, and so with all other acids. The effect of the aqua ammonia was almost instantaneous, but the window was frosted again in a short time. With the glycerine there were very good results—but slight stains on the window which were subsequently easily removed. I have had inquiries from retail opticians, who have complained about their windows being unserviceable in very cold weather, and desiring a remedy. I thought the results of my experiments would reach widest publicity through your columns, and consequently give the facts to you.—H. C. Demming in The London Optician.

NEW FRENCH ELECTRICAL HEATING APPARATUS.

ABOUT a year ago M. Le Roy made known to the French scientific societies the remarkable properties of crystallized silicon, and demonstrated that this substance had a very characteristic electrical resistance which is of great use in the generation of heat.

Since then this engineer has constructed some interesting electrical heating apparatus, in which the resistance is uniformly made up of one or more sticks of pure silicon, each of which is inclosed in a glass tube in order to protect it from oxidation. This heating stick has been named the "electric log."

The good results obtained from this apparatus come, on one hand, from the high coefficient of specific resistance of crystallized silicon (which is 1,333 times that of lighting carbon), and also, on the other hand, from the constance of the yield of heat, which, in electrical apparatus, is independent of the skill of the operator.

In order to show our readers some of the remarkable properties of the electric log, we will describe in some detail two of the apparatus which have recently been put into use.

Foot-warmer for Beds.—Fig. 1 shows a foot-warmer for berths which has recently been supplied to the International Sleeping Car and Fast European Express Company. A small dynamo is connected to one of the axles, and the variations in speed are adjusted by a very ingenious arrangement, while a storage battery completes this miniature plant.

The dynamo is capable of producing 1,000 to 1,200 watts, say 40 amperes at 25 volts. It is running continually while the car is in motion, and the battery begins to act when the car stops.

The available power is all in use when the lamps in the berths and aisles are lighted, and it is not used at all at other times. In order to use the current for heating when it is not in use for light, it is necessary to have apparatus which, while producing sufficient heat, will consume a very small amount of current, so that the heating apparatus may be substituted for the lamp and not require a special circuit of its own, with a special dynamo for generating current.

The berths of ten sleeping cars to be used on the Russian Trans-Siberian Railroad have recently been equipped with these little foot-warmers. They consist simply of an electric "log," inclosed in a tube from which it is completely insulated, and connected, by means of a flexible cord and plug, with the lamp socket. The flexible cord is long enough for the heater to be moved anywhere in the berth.

Supposing the cost of a kilowatt hour to be three cents, which is the highest price that is ever charged, even for lighting, in Paris, the hourly expense of this foot-warmer would be one cent. At a tariff of two cents per kilowatt hour, which is the usual rate at central stations, the cost would be only three-fifths of a cent.

The consumption does not exceed 35 watts per single heater, and in all the actual trials it has always been below this figure. To obtain this small consumption, it has not been found necessary to construct special heating elements, but simply to pick out, from among

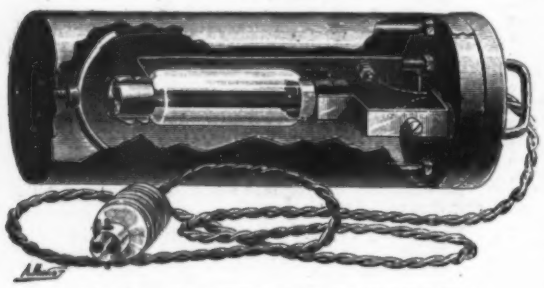


FIG. 1.—ELECTRIC BERTH HEATER.

the tested logs, those whose maximum corresponds to the temperature which it is desired not to exceed under normal conditions. In order to obtain an output of 35 watts with a potential of 25 volts, the elements are used that have been tested for 35 volts. The same results have been obtained with elements tested for 140 to 150 volts by using central station currents at 110 volts, while on boats where an 80-volt current is generally employed, elements tested for 105 volts are used.

The electric logs are gaged according to their consumption, and, as would naturally be supposed, the amount of heat they give out is proportional to the number of watts expended. They normally consume 90 watts, which raises the log to a temperature of 850°; but they may be made to take 110 to 120 watts without being damaged in the least.

Electric Oven.—The exhibition at Brussels, which the Belgian Electrical Society held recently in the new post office building of that city, for the purpose of showing the use of electricity in the home, gave M. Le Roy an opportunity of showing, for the first time, his new electrically-heated pastry oven.

Fig. 2 shows this piece of apparatus. The interior of the oven measures 26×16×15 inches. The walls of the oven are double and have a 2-inch space between them filled with amianth, the fibrous variety of asbestos. This causes very little heat to be lost by radiation.

As will be seen from the illustration, the oven has two shelves, with a row of four elements under each. A third row is placed in the top. These rows are independent of each other and can be used separately. Each one consumes 640 watts.

When the oven is cold, it takes a quarter of an hour to heat it to the proper temperature. The upper row of heating elements is then shut off and the consumption reduced to 1,280 watts. With this amount of electrical energy buns can be baked in twelve minutes and small tea cakes in less than half that time. As each shelf will hold twelve buns, twenty-four may be placed in the oven and baked. Given the cost of current per kilowatt hour, it is easy to figure the cost per bun. If the price of current is one cent, the baking of a bun would cost one-tenth of a cent, and that of a tea cake one-twentieth of a cent.

In order to appreciate the value of this system, which is all the more economical when used continuously, it is necessary to consider the practical advantages resulting from the facility of the service and the cleanliness of the oven.—Revue Industrielle.

SIR ANDREW NOBLE ON THE BEST EDUCATION FOR ENGINEERS.*

WHEN your dean first did me the honor to ask me to address you on the opening of your session, I had grave doubts as to whether I was a proper person to accept the invitation. On the one hand, I have had little or nothing to do with the education of others, and in some points my views, at all events so far as regards primary education, are at variance with much that is being done at the present day; but as, on the other hand, I have had exceptional opportunities of observing, both in this and other countries, certain points which seem to me to be of importance to those who propose to uphold the industrial supremacy of this country in the struggle which year by year other countries are rendering more and more severe, you therefore see me here to-day, and I shall consider myself amply rewarded if I can tempt but one of you to enter, for the sake of knowledge itself, the boundless field which science day by day is opening up to you. I can promise that the pursuit will give you happiness. I hope it may give you wealth and distinction; but I remember the words of the preacher, that riches are not always given to men of understanding, nor favor to men of skill, but that time and chance happen to us all.

Technical education is a phrase that has been so often misused, perhaps so often misunderstood, that many of those who, like myself, are engaged chiefly in trying to solve the practical problems of engineering are in the habit of hearing it either with impatience or of regarding it as a fad of lay theorists, or sometimes, I fear, as a cloak for educational shortcomings in other directions. And I am bound to confess, if their experience has been the same as mine, that there is some excuse for them. You can form but little idea of the number of persons of both sexes who have assured me that their sons had no taste for books, but had shown a marvelous talent for engineering. I need hardly tell you that the marvelous talent generally turns out to be an incapacity, possibly from defective education, for seriously applying the mind to any subject whatever.

But technical education, properly considered, is of the highest importance both to you and to England. It is only its abuse that we have to guard against.

Now one of the great abuses I take to be that technical education is often begun too early in life, that is, that it is substituted for a general education, and a boy attempts to put his knowledge to practical use before he has learned how to learn.

Another abuse is the divorcing of practice from theory, and the danger of elevating practical application above scientific knowledge.

I shall try, therefore, to-day to say a few words, first, about the necessity of acquiring a sound general education before any special work is attacked, and, secondly, about the necessity of basing all practical work on theoretic knowledge.

I attribute the compliment which has been paid me in the invitation to speak at the opening of the present session to the fact of my having been connected, for many years past, with the management of probably the largest engineering firm in England. That position has afforded me exceptional opportunities for observing what educational antecedents are likely to produce the best results in the engineering field. I say "exceptional opportunities" advisedly, for we at present employ in our various works not far removed from 30,000 hands. Of these a large number are youths: often sons of workmen, but not unfrequently drawn from the class which I see represented before me.

I am continually asked what education I should recommend for a lad entering Elswick. I always say, "Send your son to as good a school as you can, keep him there as long as you can, do not curtail his time of schooling, do not stunt his early intellectual growth by narrowing it down to any special study as taught at elementary schools."

Science, mechanical drawing, and such like are no doubt very useful (as all knowledge is useful) in their way. These studies may prove an irresistible attraction to minds with a strong bent toward scientific subjects, but I would fancy most employers would rather that a lad came to us blankly ignorant of both, so long as he had had a good education, had been taught, and had ability to think, and to concentrate his attention on any subject brought to his notice.

Some of you may have heard, no doubt, the answer of the Duke of Wellington to a father who asked him what was the best education for his son, preparatory to his joining the army: "The best education you can give him."

It was a very pregnant utterance, terse and to the point, as nearly all the great Duke's were; and it remains as true for any other profession as for the army.

In nine cases out of ten, I should say, any knowledge acquired by a boy before he is sixteen can have but a slight intrinsic value. Up to that age, it is not what he learns that we have to look at, but how he learns; it is the habit of discipline, of mental application, of power in attacking a subject, that are so valuable; not, generally, any definite piece of knowledge he may have gained.

According to my experience, the most valuable knowledge that a man has at his disposal is that which he has taught himself. That a special technical education is not an absolute necessity is not difficult of proof. My own chief, Lord Armstrong, commenced life as a solicitor; James Watt was an instrument maker, and was prevented from opening a shop in Glasgow because he had not served a full apprenticeship. George Stephenson was an assistant fireman to his father at Killingworth Colliery. Faraday was brought up as a bookbinder. I cite the cases of these great men simply to show how men without trained assistance have taught themselves, and what can be done by the dauntless energy, untiring industry, and patient search after truth which were the great characteristics of all of them, and which enabled them to do such great things.

My own impression with regard to early education is that, as a sharpener of the young intellect, and as a mental discipline, it would be difficult to improve upon the curriculum which is now in force at our public schools, and which, in the main, has been in force for so many centuries.

I am not in accord with those who think that modern languages should supersede the classics as a means of education, and I should regret more than I do the attempts which have been made in this direction, did I think that these attempts were likely to be successful. Men of science will remember that practically the whole of our scientific nomenclature is borrowed from the Greek and Latin languages; and, personally, I have found my own knowledge of the classics, which represents, no doubt, that of a very ordinary schoolboy, stand by me and enable me to enjoy, as I would not otherwise have done, that noble literature which, as Lord Macaulay says, is the most splendid and perhaps the most durable of the many glories of England.

But, whatever may be the fate of the classics as a means, I must take up my parable against a course of education I have seen in several primary schools where an attempt is made to teach boys, often little better than children, rudimentary chemistry, rudimentary geology, also physiology and electricity.

Occasional popular lectures on these sciences may be of very great value to some boys in interesting them in these great subjects, and in leading them, at some later date, seriously to study them; but these sciences as taught in the schools I refer to can have but little value in encouraging habits of thought, of

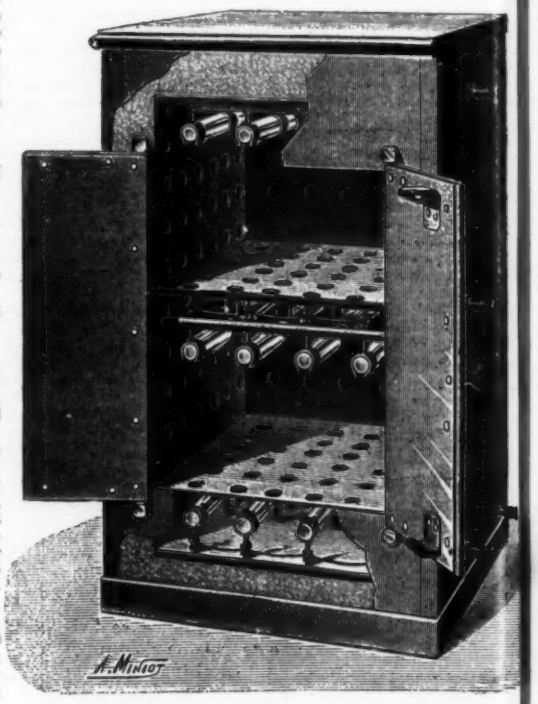


FIG. 2.—ELECTRIC WARMER FOR PASTRY.

application, and of mental discipline; and to knowledge so acquired the words of Pope are peculiarly applicable:

"A little knowledge is a dangerous thing,
Drink deep or taste not the Pierian spring;
There shallow draughts intoxicate the brain,
And drinking deeply sobers it again."

I am aware that many people say that the years a boy wastes on Greek and Latin might be better employed in learning German and French. It may be so, but it is not difficult to teach these most important languages colloquially at a very early age; and with regard to technical subjects, speaking from my own observation, I may say that I do not think I have known any man at twenty-eight or thirty who was the better for having abandoned his general education for technical subjects at too early an age.

Those men who, with fair abilities, have received a really good education, have been taught to use their minds, and who, by contact with other students, have acquired habits of application, amply make up for their late start by the power of mind and grip that they bring to their work. They are fresh and keen when others, who have been hammering away at semi-technical work from early boyhood, have become stale and are less vigorous, and that reflection moves me to deprecate strongly any attempt to teach seriously practical or electrical engineering in preparatory or elementary schools. As an excellent recreation, such studies are no doubt to be encouraged, but to make them a systematic part of education, to the exclusion of studies which have a more direct effect in developing the understanding, seems to me to be entirely wrong. I would go further and say that even in public schools, and their equivalents, for older boys, what are termed engineering shops are generally a failure, so far as any efficient knowledge to be gained in them is concerned. Except as a reasonable diversion for recreation hours, such "shops" have, I fear, but little value, and in nine cases out of ten the hours spent in them are subtracted from the time due to more valuable studies.

In my judgment, the age at which a boy should seriously begin any special studies, with a view to fit him technically for the profession he may have decided

* Inaugural address of the session 1899-1900 of the City and Guilds Central Technical College, given at the college, Exhibition Road, by Sir Andrew Noble, K.C.B., F.R.S., on Tuesday, October 3.

to follow, should not be earlier than seventeen or eighteen.

And in any discussion as to the age at which a boy should leave school, the great incidental advantages that he gains from a reasonable prolongation of his schooldays must never be lost sight of. A stricter discipline, a wiser supervision, a more authoritative yet sympathetic advice as to conduct, are more possible at school than can ever be the case in after life, and a more constant association with his equals rubs off angularities and leads to amenity of disposition.

So much for the necessity of grounding technical studies on the basis of a sound general education.

The next point I should like to urge is that any practical technical instruction and any practical knowledge acquired in the workshop should be based upon sound theoretic knowledge. I am driven to enforce this question because (speaking again from my own observation) I find that in this country far too much weight is given to practical skill and what is called "the rule of thumb;" far too little to sound theoretic knowledge.

In the middle of this century English machinery was immeasurably superior to any other. To our remaining content with this state of things, and to our seriously neglecting technical instruction, I attribute the very much greater comparative progress that Germany, the United States and Switzerland have made in the last fifty years; and, if I am not very greatly mistaken, we shall have before many years, in the East, an important commercial rival in Japan, since that country is developing its manufacturing powers with an energy that is as remarkable as it is unexampled.

Turning to other departments of industry, no Englishman can observe without regret how certain branches have almost altogether abandoned this country, and been in a great measure left to those who have paid more attention to technical instruction.

Nearly every requirement of a drawing office can be better and more economically obtained from Germany. From what source do all our pure chemicals come, our filter papers and most of our glass apparatus? I admit that the workmanship of many articles made in England cannot be surpassed, but if we require any original or special piece of apparatus, we are frequently compelled, as I have been, to go to Germany or France for their manufacture.

I do not desire to press my point too far, and admit that a portion of this transference of work, which I so much regret, may be due to cheaper labor. But the English mechanic is second to none, and if that false trade unionism which endeavors to prevent the most intelligent and skilled from reaping the full benefit of their abilities be abandoned, I do not despair of seeing this country regain much that it has now lost.

But it is to theoretic and technical knowledge that we must chiefly look. Consider, as an illustration, electricity in the service of man. Think of its innumerable applications, and of the number of hands dependent upon its industries. But for one man capable of designing or improving these powerful machines or delicate instruments, there are a thousand ready and able to carry out their designs. But it is the former who are the salt of the earth, and those who have the management of large concerns know well how to value them.

It was to meet the want that I am referring to that your Technical College was founded. Its objects are admirably stated in its programme, and your attention is drawn to the undoubted fact that no theoretic or technical instruction can supersede the necessity of obtaining practical experience in the workshop and factory. But, on the other hand, I believe that no genuine success in the higher walks of industry is probable without thorough theoretic or technical knowledge.

In my experience I do not think I have ever known a man rise to the top of the tree without it. I may, perhaps, be forgiven if I refer to one great engineering genius, Lord Armstrong, with whom it has been my privilege to be so long and so intimately connected. In whatever investigation he was engaged, he added to sound theoretic knowledge an intensity of application and an apparently intuitive perception of the results to be expected that I have rarely seen equaled.

Of him it may be truly said that "whatever his hand found to do, he did it with his might."

Sir William Harcourt, speaking a fortnight ago, attributed the immense commercial advance which has recently been made by Germany to the better teaching of languages, and to the German merchant being able to speak to the English buyer in a tongue which he can understand. I very much doubt if that has much to do with the matter, and I am sure that houses where business is done on a large scale very much prefer that all letters should be in the languages of the respective writers, and not in the doubtful English that is not unfrequently thrust upon us. There is no doubt that Germany is competing with us, as she has a right to do, successfully; and, so far as I am aware, with respect to her manufactures, perfectly honestly.

I say "honestly," because I do not believe in any attempt to enhance the value of one's own wares by depreciating those of other people; and I entirely differ from those who would attribute the success of our German competitors to their putting on the market inferior goods specially got up to imitate those of a superior class. It was some idea of this kind, no doubt, that led to the most ill-advised regulation that foreign-made goods should be stamped so as to show their origin. It doubtless does this, but its effect is, I believe, in the direction of an advertisement for foreign goods, and there is some danger that if our own manufacturers relax their efforts, the "made in Germany," which was, I think, meant to be a reproach, should become, on the contrary, a hall-mark of excellence, as when the "Wilhelm der Grosse," one of the finest steamships afloat, steamed into Southampton Water with a facetious placard, "Made in Germany," hanging on her side.

In many articles, and especially with the apparatus of scientific research to which I have referred, this is already the case.

Manufacturing progress has in Germany gone hand in hand with material progress, and any one who has traveled much must be astounded with the extraordinary improvement which has been going on in recent years, not only in German railways, shipbuilding, and steel working, but also in the buildings, order, and general amenities of life of the great German cities, such as Berlin, Frankfort, and Cologne. In the competition of manufacture we are pressed very hard from steel to watches, from marine engines to scientific instruments. In nothing, indeed, have German manufacturers made more progress than in the making of all exact instruments. In these departments Germany certainly excels us, so far as original and inventive improvement is concerned.

Now, all this improvement, I feel inclined to attribute, not, with Sir William Harcourt, to any linguistic superiority, but to the far greater opportunities of technical study which are afforded in Germany. If we are to hold our own, we older men must try to multiply these opportunities of study in our own country, and you younger men must do your part by seeking to avail yourselves to the uttermost of any such opportunities provided.

To you, gentlemen, who are about to commence the studies which will be useful to you in your future career, I venture to say a few words. Consider the marvelous progress that has been made in the physical and practical sciences during the century now rapidly drawing to a close. At the commencement of the century steam navigation and railways were unknown and unachieved. Our knowledge of the science of electricity was confined to a few isolated phenomena, and chemistry was in its infancy. Now the latter science has spread its branches until it seems likely it may bring into a common brotherhood the whole of the physical sciences. Consider, further, that knowledge and progress appear to be increasing in a geometric ratio; who, then, can predict what will be the progress made at the conclusion of the twentieth century, or even during the first half of it? In forwarding that progress I sincerely trust that many of those whom I now address may be prominent workers. We have never wanted in this country the men whom I would call the captains of the scientific army, but I think we are much inferior to Germany in the rank and file, in the number of men who are willing to follow particular lines of investigation, and who thus do invaluable service to science.

We older men, whose careers are approaching their termination, cannot but look with envy on the career which may be open to some of you. It was said of the telescope, which opened to our vision infinite space, that it was balanced by the microscope, which showed us the infinitely small; but small as are these objects, the kinetic theory of gases opens up to our appreciation, I had almost said to our view, molecules whose dimensions are inconceivably smaller. It would be vain to name to you the limiting dimensions of these molecules which have been revealed to us by the labors of Maxwell, Lord Kelvin, Clausius, and others, but I have seen somewhere, possibly in the columns of Nature, a statement which may be more intelligible. It was something like this: That, though the molecules of hydrogen gas are so small that it would take about 50,000,000 touching one another to make an inch, they are so numerous in a cubic inch of gas at 0° Centigrade and atmospheric pressure that if the whole of them were formed into a row they would go round the circumference of the earth more than a thousand times. The molecules also, as you probably know, are in violent motion. The highest velocity I have obtained with a projectile nearly reached 5,000 f.s., but the average velocity of the hydrogen molecules at the temperature and pressure I have named is somewhat more. I once calculated that a few molecules, I forget in how many millions, might exceed 50,000 f.s.

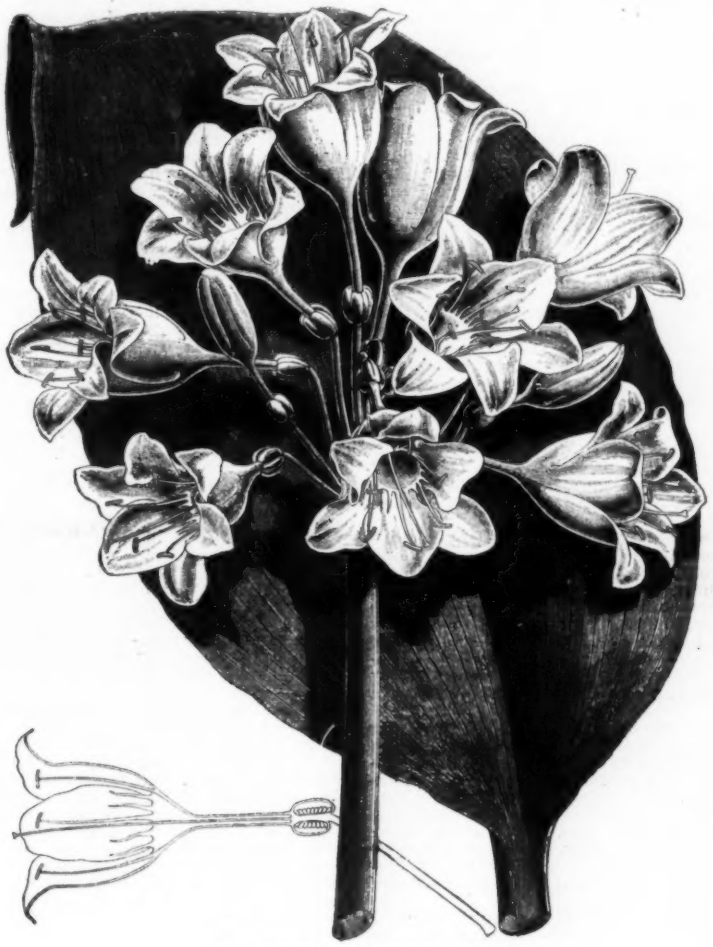
We smile, and justly smile, at the seekers after what was called perpetual motion. Modern science seems to show that it is equally vain to seek for anything that is perpetually and absolutely at rest.

I have alluded to the kinetic theory of gases because we know more of the constitution of that form of matter than we do of any other, but having regard to the progress of science to which I have referred, is it too much to hope that some of you will live to see a second Newton, who will give you a second Principia, which shall clear away the difficulties which surround the constitution of matter whether ponderable or imponderable?

One word more: bring enthusiasm to your studies; without it the best instruction (this you will have) and the best apparatus will do nothing for you. Make your work the first aim, and do not let athletics or anything else take precedence of it. Here, again, I cannot help thinking that the Germans get a little the better of us. With them work is absolutely in the forefront; I am not at all sure that it is so with the average young Englishman of to-day. No one appreciates the value of athletics, when kept in their proper place, more keenly than I do. But against the substitution of athletics for the more serious objects of life, I should like to enter my strongest protest, and it will be a sorry day for England if such a change ever takes place.

Lastly, I would say to you, while giving the acquiring of knowledge that may assist your own business or profession the first place, not to be too utilitarian, do not narrow the search for knowledge down to a search for utilitarian knowledge, for knowledge that you think will pay. I remember a strong protest of De Morgan's against the number of men who take their station in the business of life without ever having known real mental exertion; he put it that knowledge which ought to open the mind was decided on solely by its fitness to manure the money tree.

Therefore, above all things, pursue knowledge. It is that pursuit which will stand by you to the end as at once the greatest and the most enduring of pleasures. Friends may die; the most tender attachments must be severed; advancing years will very soon debar you from any serious pursuit of athletics; the acquisition of wealth will take away from you the pleasure of "making a position," which is probably the keenest, and surely the most legitimate, incentive of middle life; but the pleasure of acquiring knowledge will console you to the last, so long as you have strength to open a book or to hold a test tube. Cry after knowledge; seek for her as silver; and search for her as for hidden treasure.



URCEOCHARIS CLIBRANI.

URCEOCHARIS CLIBRANI.

THE genus Eucharis contains six fairly well marked species, among which the well-known E. grandiflora ranks first and foremost as a garden plant. All have white flowers of great beauty. They are natives of the Andes and New Granada, occurring at low elevations. The treatment required by E. grandiflora will suit the others, whether hybrids or species. A hybrid has been obtained between E. grandiflora and Urceolina pendula, called Urceocharis Clibrani, which is shown in our illustration. Some gardeners do not like the hybrid so well as either of its parents. This hybrid should draw the attention of hybridists to Urceolina miniata, a pretty plant with bright scarlet flowers.

We should probably have something good if this color could be infused into the Eucharis by inter-breeding.—Gardeners' Chronicle.

MIND AND MORALS IN ANIMALS AND SAVAGES.

By A. O'NEILL DAUNT.

WITH regard to the intelligence of ants, I take the following from Romanes. Prof. Leuckart placed round the trunk of a tree which was visited by ants as a pasture for aphides, a broad cloth soaked in tobacco water. When the ants, returning home down the trunk of the tree, arrived at the soaked cloth, they turned round, went up the tree again to some of the overhanging branches, and allowed themselves to drop clear of the obnoxious barrier. On the other hand, the ants which desired to mount the tree first examined the nature of the barrier, then turned back and procured from a distance little pellets of earth which they carried in their jaws, and deposited one after another upon the tobacco cloth till a road of earth was made across it, over which the ants passed to and fro with impunity. Romanes observes that this interesting observation of Leuckart's is a corroboration of an almost identical one made more than a century ago by Cardinal Fleury, and communicated by him to Reaumur, who published it in his "L'Histoire des Insectes," in 1734. The Cardinal smeared the trunk of a tree with birdlime in order to prevent the ants from ascending it; but the insects overcame the obstacle by making a road of earth, small stones, etc., as in the case just mentioned. The Cardinal also in another instance saw a number of ants make a bridge across a vessel of water surrounding the bottom of an orange tree tub. They did so by conveying a number of little pieces of wood, the choice of which material, instead of earth, stones, etc., as in the previous case, seems to betoken no small knowledge of practical engineering.

Büchner, as quoted by Romanes, records a similar exhibition of intelligence: The ants behaved in a yet more ingenious fashion under the following very similar circumstances. Herr G. Theuerkauf, the painter, writes to the author, November 18, 1875: "A maple tree standing on the ground of the manufacturer, Vollbaum, of Elbing (now of Dantzic), swarmed with aphides and ants. In order to check the mischief, the proprietor smeared about a foot width of the ground round the tree with tar. The first ants who wanted to cross naturally stuck fast. But what did the next? They turned back to the tree, and carried down aphides which they stuck down on the tar one after another, until they had made a bridge over which they could cross the tarring without danger. The above named Vollbaum is the guarantor of this story, which I received from his own mouth on the very spot whereat it occurred."

Of ecitons, Mr. Belt says:

"I shall relate two more instances of the reasoning faculty in these ants. I once saw a wide column trying to pass along a crumbling, nearly perpendicular slope. They would have got very slowly over it, and many of them would have fallen, but a number having secured their hold and reaching to each other remained stationary, and over them the main body passed.

"Another time they were crossing a watercourse along a small branch not thicker than a goose quill. They widened this natural bridge to three times its width by a number of ants clinging to it, and to each other, on each side, over which the column passed three or four deep; whereas, excepting for the expedient, they would have had to pass over in single file, and treble the time would have been consumed. Can it be contended that such insects are not able to determine by reasoning powers which is the best way of doing a thing?"

When ants have to cross a stream too wide for branches to span, they use chips of wood as rafts, and these are joined together by a chain of ants which hold on to each other till the strain from the stream becomes unequal to their strength. These sections continue their voyage, the ants on the shore meantime constantly launching fresh rafts, which are built up into sections and manned, shoved off, and are again broken up in the same manner. Thus the process continues until the whole body of the insects has crossed the water.

Dr. Lincecum writes as follows of the ant farms:

"There can be no doubt of the fact that the particular species of grain-bearing grass mentioned above is intentionally planted. In farmerlike manner, the ground upon which it stands is carefully divested of all other grasses and weeds during the time it is growing. When it is ripe, the grain is taken care of, the dry stubble cut away and carried off, the paved area being left unencumbered until the ensuing autumn, when the same 'ant rice' reappears within the same circle, and receives the same agricultural attention as was bestowed upon the previous crop—and so on, year after year, as I know to be the case in all situations where the ants' settlements are protected from graminivorous animals."

In a subsequent letter to Darwin, Dr. Lincecum further says: "I have not the slightest doubt of it (i. e., that ants plant seeds for a crop), and my conclusions have not been arrived at from hasty or careless observations, nor from seeing the ants do something that looked like it, and then guessing at the results. I have at all seasons watched the same ant cities during the last twelve years, and I know what I stated in my former letter is true. I visited the same cities yesterday, and found the crop of ant rice growing finely, and exhibiting also the signs of high cultivation, and not a blade of any other kind of grass or weed was to be seen within twelve inches of the circular row of ant rice."

Romanes, after alluding to Pliny's assertion that certain ants in the south of Europe practiced the strange habit of interring their deceased friends, quotes the following account of an observation by Mrs. Hutton, who, having killed several soldier ants, returned half an hour afterward to the place where the bodies were lying, and thus describes what she saw:

"I saw a large number of ants surrounding the dead ones. I determined to watch their proceedings closely. I followed four or five that started off from the rest toward a hillock a short distance off in which was an ants' nest. This they entered, and in about five minutes they reappeared, followed by others. All fell into rank, walking regularly and slowly two by two, until they arrived at the spot where lay the dead bodies of the soldier ants. In a few minutes two of the ants advanced and took up the dead body of one of their comrades; then two others, and so on, until all were ready to march. First walked two ants bearing a body, then two without a burden, then two with another dead ant, and so on till the line was extended to about forty pairs, and the procession now moved slowly onward, followed by an irregular body of about two hundred ants. Occasionally the two laden ants stopped, and laying down the dead ant, it was taken up by the two walking unburdened behind them, and thus by occasionally relieving each other, they arrived at a sandy spot near the sea.

"The body of ants now commenced digging with their jaws a number of holes in the ground, in each of which a dead ant was laid, where they now labored on until they had filled up the ants' graves. This did not quite finish the remarkable circumstances attending the funeral of the ants. Some six or seven of the ants had attempted to run off without performing their share of the task of digging; these were caught and brought back, when they were at once attacked by the body of ants and killed upon the spot. A single grave was quickly dug, and they were all dropped into it."

This evidence of intelligent action on the part of ants might be extended indefinitely did space permit. It is not necessary to take each link in the zoological chain, and to study the evidence afforded by it in favor of the contention that the minds of animals, as exhibited by their actions, appear to be essentially the same in kind as that of man. A few examples taken at random will suffice. As so much has been written of the intelligence of the dog, I shall not notice this animal, but only such as live in natural freedom.

In Vol. VIII. of the "Miscellaneous Publications of the United States Geological Survey," Captain Elliot Coues thus describes the ingenuity of the wolverine:

"At Peel's River on one occasion a very old carcajou discovered my marten road (i. e., line of traps set for martens), on which I had nearly a hundred and fifty traps. I was in the habit of visiting the line about once a fortnight, but the beast fell into the way of coming oftener than I did, to my great annoyance and vexation. I determined to put a stop to this thieving and his life together, cost what it might. So I made six strong traps at as many different points, and also set three steel traps. For three weeks I tried my best to catch the beast without success, and my worst enemy would allow that I am no green hand in these matters. The animal carefully avoided the traps set for his own benefit, and seemed to be taking more delight than ever in demolishing my marten traps, and eating the martens, scattering the poles in every direction, and caching what baits or martens he did not devour on the spot. As we had no poison in those days, I next set a gun on the bank of a little lake. The gun was concealed in some low bushes, but the bait was so placed that the carcajou must see it on his way up the bank. I blockaded my path to the gun with a small pine tree, which completely hid it. On my first visit afterward I found that the beast had gone up to the bait and smelled it, but had left it untouched. He had next pulled up the pine tree that blocked the path, and gone around the gun and cut the line which connected the bait with the trigger, just behind the muzzle. Then he had gone back and pulled the bait away, and carried it out on the lake (i. e., on the ice), where he lay down and devoured it at his leisure. There I found my string. I could scarcely believe that all this had been done designedly, for it seemed that faculties fully on a par with human reason would be required for such an exploit, if done intentionally. I therefore rearranged things, tying the string where it had been bitten. But the result was exactly the same for three successive occasions, as I could plainly see by the footprints; and what is most singular of all, each time the brute was careful to cut the line a little bit back of where it had been tied before, as if actually reasoning with himself that even the knots might be some new device of mine, and therefore a source of hidden danger he would prudently avoid—I came to the conclusion that that carcajou ought to live, as he must be something at least human, if not worse. I gave it up, and abandoned the road for a period."

This curious animal has the singular habit of shading his eyes with one of his forepaws when carefully scrutinizing an object at a distance.

I must now say a few words on the moral sense of animals. I have already adverted to the fact, which has been frequently observed to occur, that animals are capable of risking and even sacrificing their lives in the service of others. Why should we, when we behold an instance of this disinterestedness, ungenerously ascribe it to any lower impulse than we should in the case of a similar act on the part of a human being? It is "instinct" we are told; and we are further told that instinct arises as the mechanical result of millions of actions of the same kind in the life history of the species. A moment's reflection will show the absurd inappropriateness of this explanation of such actions, not to speak of the insufficiency of such a theory of the origin of instinct. In general, where animals exhibit unselfishness, courage in facing danger to aid others, make intercession in combat, show conciliation and love of knowledge and hospitality, evince interest in the proceedings of their fellows or of man, and sympathy in their sufferings, seem actuated by a sense of duty, and show a sense of personal merit for actions worthily performed, a selfish end for these manifestations is too often asserted to be the motive. But before we judge animals thus harshly, let us reflect that in similar cases man himself no less frequently (and, I believe we may assume, much more frequently) is actuated by selfish and interested personal ends. Lindsay says that animals possess a sense of right and wrong, with a power of choice between them; that they commit crimes and are aware of the criminality of their acts; that they have a wonderful power of self-control, and possess not only a moral, but even a religious sense (presumably meaning a sense of reverence), including a conscience. They also have a knowledge and dread of consequences; can deliberate and decide on proposed courses of conduct; have freedom of will and the faculty of voluntary action. They can balance or weigh present or immediate pleasures against prospective pains; appreciate rewards or punishments; perceive and correct their own mistakes, as well as frequently those of man; have a knowledge of duty and of trust. From these attributes he infers the possession of a sense of responsibility, which is realized by all those who base their system of training and education of animals on rewards and punishments. This possession of responsibility appears to have been understood by the Jews, according to whose law (Exodus xxi., 28–33) an ox that had gored a man or woman was condemned to be stoned to death. Draper states that a horse, which had been taught many tricks by its master, was adjudged to be burnt to death at Lisbon 1601, as being possessed by the devil. During the middle ages similar instances of animal execution for crime were numerous. Sometimes even animals had to pass through the ordeal of combat, a champion being assigned to them. Pierquin says that dogs have been accepted as witnesses in courts of justice. It is well known that man has often trained dogs to act as his accomplices in crime, and by a perversion of justice, the animal has been condemned to death and his more guilty owner allowed to go free.

Innumerable instances could be quoted to show the love of animals for their offspring, their self-abnegation for the advantage, comfort, or preservation of their young. In this alone how often they set example to man, who even in civilized communities so far falls short of them in this virtue as to render necessary the establishment of protection societies for children in our chief towns and cities. The late Lord Beaconsfield said that infanticide was as common in England as upon the banks of the Ganges. In fidelity and unswerving affection of the most unselfish kind, what an example have we in the dog! Sometimes this is equally observable in women; seldom in a man. What a religious moral, too, may be drawn from this devotion of the animal to his master, who is his god! Would that man with his boasted pre-eminence would imitate his humble friend, and evince a like devotion and love toward his God!

It is now necessary to turn from animals to man, and to consider what are his characteristics as visible in the savage state, and how the outcome of his "reason" compares with that of the intelligence of animals. In the first place, let us inquire what amount, if any, of religious sense actuates a low type of savage. Lindsay says that missionaries, traders, or travelers in various parts of the world, as well as naturalists, who are closer observers, inform us that there are, or were, certain savage races utterly destitute of any religious sense whatever, having apparently no idea of personal responsibility, no sentiment that could be characterized as religious, no form of worship, and no observance. The Rev. William Colenso, of Napier, New Zealand, says that the Maoris had no form of religious worship, and that whether we define religion as reverence toward God, or as a form of fear of future punishments, or as a hope of reward, they equally were devoid of it; the idea was wholly absent from their minds. God was not to them even a vague abstraction; they knew nothing of Him; they did not even practice idolatry, having no idols. They paid no worship to any object evident to their senses, neither to the sun, moon, stars, nor to any personification of natural forces. Another writer quoted by Lindsay says of them: "The great fact observable from a consideration of their traditions . . . . is that the people had no idea of a Supreme Being, the Creator of all things in heaven and in earth." These observations are accurately descriptive of many other savage tribes in various countries. It is apparently true that while among some savage peoples an idea, however dim, which might be described as religious prevails more or less, there yet are other peoples so low in the scale of intellectual development as never to have formulated any kind of theory of a religious character. When Moffatt, the well known South African missionary, first visited the Bechuanas, he found that they had absolutely no idea of a God, nor had they any conception of a future state. They had not even any idols, and on one being shown to a chief as the object of adoration by other men, he could not repress his amazement, observing that he did not understand how anyone could be found foolish enough to worship an article made by his own hands. This total absence of a religious sense was also noticed by Dr. Livingstone among the Makondes in the Rovuma country. "They knew nothing," he says, "of a deity; they pray to their mothers when in distress; they know nothing of a future state, nor have they any religion except a belief in medicine. They blame witches for disease and death. . . . They fear the English." Dr. Nixon, Bishop of Tasmania, says that he was obliged to desist from all attempts at conversation because the poverty of the native language, and of their conceptions, was such as rendered every higher religious idea impossible to them. The Andaman Islanders are described as similarly destitute of the religious sense, Jesuits and Moravians having both failed to impress them. Sir Samuel Baker gives a like character to the natives of the Albert N'yanza region, where he was informed by the head of the Austrian Mission that "the mission was absolutely useless among such savages." In other portions of Africa the same observations have been made. At Dahomey the natives have no conception of God, neither have they any belief in future rewards or punishments. Baker and Hartshorne state that the Veddas of Ceylon are wholly ignorant of the existence of God, of the soul, of life after death. Yet in this instance there appears a faint trace of some superstition connected with death, as they make an offering to a deceased friend; but whether it be simply a mode of commemorating him does not appear.

Another authority, who had the advantage of observing them personally, expresses the belief that they know nothing whatever of anything having a religious significance. The same ignorance prevails among the Angolese. Of King Kamrasi, in the N'yanza region, Baker observes that "in this wild, naked savage there was not even a superstition on which to found a religious belief."

It is needless to adduce testimony from the many regions on the globe in which this dense ignorance exists, in order to show that man in the natural state is not necessarily informed by his reason of his personal responsibility to a Supreme Being for his actions in this life, and of a state of reward or punishment in the next proportionate to his merits. Let us rather view him in his social relations, and try to ascertain whether his limited intelligence differs in kind from that of the animals by which he is surrounded.

Buchner, writing of certain aborigines of Borneo, says that they are destitute of an articulate language of their own, and only learn with difficulty to pronounce a few Malay words.

Much of the language of certain tribes, such as the natives of the Philippines and the bushmen of South Africa, consists largely of inarticulate sounds, clicks, facial grimaces and gestures. When wishing to converse at night, a traveler states that it is necessary for them to halt and make a fire in order that by its light this gesture language may be read. The Apache also communicates rather by gesture than by sounds.

It is said that the language in use among the Fanns of West Africa is so little like human speech that that term is inapplicable to it.

With regard to the mental status of the savage, there appears to be a consensus of opinion that certain races are unimprovable, incapable of progress. For thousands of years the ape men of India have lived in trees, and they still do so in common with monkeys. The Bukones live on a framework or platform of sticks among the branches of the trees, the construction very much resembling the roost of the anthropoid apes. The Veddas live like the animals, anywhere or anyhow. No progress has taken place among such races, nor do they seem capable of it.

Some savages are incapable of counting to five, many cannot count to ten. Countless tribes go naked, having no sense of modesty. When the Ladrone Islands were first visited by the Spaniards, the natives were ignorant of the use of fire. Many tribes or nomadic parties do not cook their food, eating their meat raw. Others are known to eat dirt, ordure, carrion; parturient mothers devour their own placenta.

Cannibalism is well known to be practiced by certain tribes; some eat their own children or other relatives. The Uaupes disinter their dead, burn them, and swallow the ashes. Personal cleanliness is as little known among many savages as among some animals. Filial affection is unknown. A father having died during the night, his sons heaved his body over the camp fence to the hyenas, and next morning amused themselves by kicking the skull round the kraal like a football. Gorging and sleeping are all the ideas of happiness formed by a bushman of South Africa.

Savages are also characterized by an absence of even the most ordinary foresight, although continually suffering from the want of it. The Caribs formerly possessed no appliances for fishing. The Mincopies or Andaman Islanders have hardly any tools; the Abyssinian Dokos possess no weapons. Some savages tear off the husk of cocoanuts with their teeth, using hands and feet to hold the nut like a monkey. Doko mothers are said to suckle their children but for a short time, abandoning them without scruple. This practice has also been observed among some of the natives of Australia. Richerer accuses the bushmen in South Africa of smothering or strangling their children when there is scarcity of food. Some of the Indians in Northwestern America allow their aged to die of hunger for the same reason. Buchner says that in New Caledonia the aged are buried alive.

Many savages evince no respect for the dead, nor have they any rites of interment. Veddas seem unable to distinguish between colors. The animal faculties of keenness of scent, sight, hearing, sense of direction, are highly developed. Lindsay says that so stupid are some of the aborigines of Australia and Borneo, that they are unfit to be used as slaves. He quotes testimony to show that the Mincopies are untamable, and states that among the Veddas memory is almost wholly absent, instancing that a man could not even remember the name of his wife until he happened to see her, when he mechanically uttered it. He ascribes to the lower types of savages in general, incapacity of generalization, want of originality, ignorance of arithmetic, absence of idea of time, of the idea of knowledge, of legislation, of social laws or regulations, want of the idea of property among some Australians; ignorance of history; want of policy or plans of action, of government, as among the Dokos, of commerce, of agriculture, of any industry, of money or its equivalent, of arts, absence of laughter, as in the Veddas, of facial expression as in the Digger Indians and Botocudos, of specific language as in the Mincopies, hence of conversation, of salutations, as in the Apaches. In beings such as these the reasoning faculty seems to be in abeyance. Their social and intellectual status compares unfavorably with that of ants or bees; their morals are below those of anthropoid apes, or animals in general. The animal mother defends her offspring at every cost; the human savage mother, to avoid a little inconvenience, puts it to death. The animal detects incapacity in its young to feed itself (as happens in cases of imbecility), and supplies it specially with food, as has been noticed by Houzeau; man would not often determine the cause. A writer instancing the stupidity of the Africans in British Guiana says that their natural stupidity borders so nearly on imbecility, dementia, and amentia that it is difficult to say where a normal state ends and an abnormal one begins. There is hardly a condition of the animal mind which has not its analogue in that of man. Every cause which arouses mental activity in the animal is evidenced in the same manner in man; such incentives as grief, joy, pain, and hope, fear, love, reverence, gratitude, honesty, sense of trust, obedience, love of offspring, caution, the musical sense, anger, suspicion, revenge, sense of humor, and many others, produce action in animals identical with the results in man. Animals possess will, memory, understanding, exhibit purely instinctive and reflex actions as does man; fear death, and have often been credited with superstitious terror. Aquinas expresses the opinion that animals have souls, which, however, he gives them in common with plants, but to which he denies immortality.

With regard to this limitation it is only necessary to say that we can believe it when we find a single instance of anything which, having once come into being, ceases to be. It is against all analogy in Nature. Are we to admit immortality, unending existence, for the ultimate elements of the animal body, the inferior part, and deny it to the soul, the vital principle, the superior part, for which the former merely serves as the habitation. It would then appear that the evidence furnished in the case of man for the possession by animals of a mind only differing from the intelligence of the human in degree and not in kind must be held also to infer their possession of a soul. If this be so, and I do not know of any more valid objection to it than theological prepossessions and prejudices, we must be prepared to consider the question of the rights of animals from a new and advanced standpoint. However this may be, I think an impartial review of the evidence for the identity in kind of the animal and human mind, especially in the light afforded by the doctrine of evolution, must satisfy any but the irreconcilably prejudiced. The subject is a vast one, and I have, I fear, done it scant justice; but I trust I have said sufficient to show that it is not one which can be regarded as closed by the decisions of certain old-fashioned authorities.—The Humanitarian.

THE NEW AUTOMATIC PISTOL OF THE GERMAN ARMY.

FOR the arming of its officers, Germany has just brought into service a new ordnance pistol with a central magazine, and which is much superior to all weapons of the kind known, especially to the revolver. It is capable of firing ten shots in succession.

The loading is done automatically through a utilization of the force of recoil and a new application of the principle already brought into play in the Maxim gun and in the rapid fire artillery.

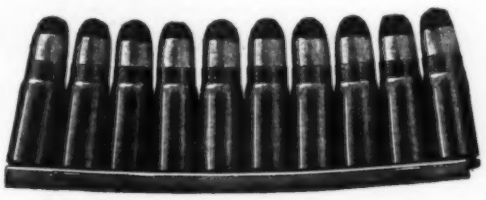


FIG. 2.—LOADER CONTAINING TEN CARTRIDGES.

After each shot, the movable breech piece, pushed backward, causes the operation of: 1, an extractor that removes the empty shell; 2, a carrier that brings a new cartridge opposite the breech; 3, a hammer that is cocked for the next shot; and 4, a spring which, in relaxing, pushes home the cartridge presented by the carrier.

In order to fire the pistol, the marksman has merely to press the trigger; and in doing this, does not tire his finger in order to effect any maneuver, as he would in the case of a revolver, in which the barrel is controlled by the trigger.

In Fig. 1 the pistol is represented upon a slightly reduced scale. The magazine, which is in the center of the weapon, forms a rectangle in which the ten cartridges are so arranged that one laps slightly over the other, so as to save space. The cartridges are introduced by hand through an aperture located above.

Each series of ten cartridges is contained in a loader consisting of a metallic plate the edges of which are provided with grooves that hold the shells through their flange.

When the breech is open, it suffices to introduce a loader into the aperture in order to provide the magazine with its ten shots. It takes no longer to perform this operation than it does to introduce one cartridge into an ordinary weapon.

Finally, a combination which is as simple as it is ingenious permits of the instantaneous conversion of the pistol into a carbine by utilizing its case as a butt-end. This case, which is of wood, has the external form of the butt-end of a gun. Fig. 3 shows the aspect of the case with the pistol inclosed, and Fig. 4 shows the pistol mounted as a carbine, with its case affixed as a butt-end.

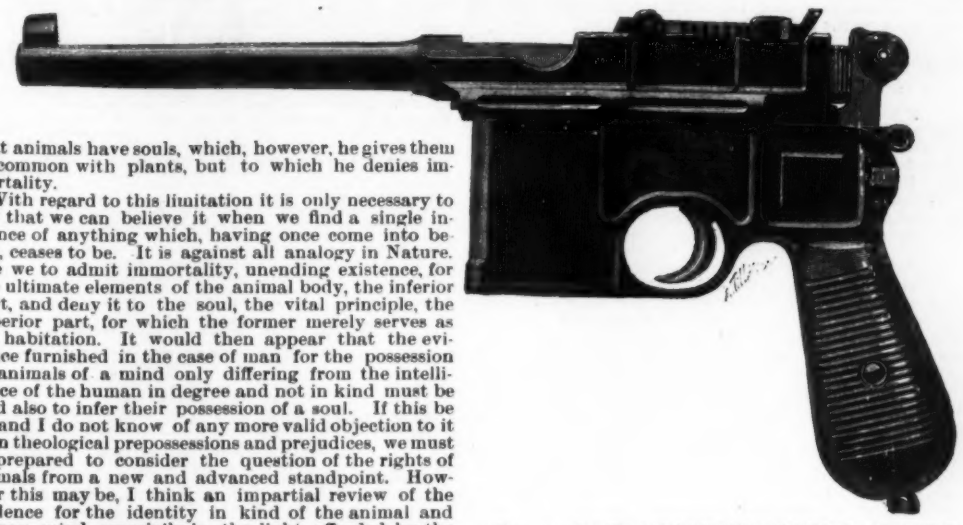


FIG. 1.—NEW AUTOMATIC PISTOL OF THE GERMAN ARMY.

The loader is represented of actual size in Fig. 2. The ball, which is of hardened lead, weighs 88 grains. Beneath its conical tip it is provided with a ring of lead alloyed with nickel. The caliber is 0·3 inch. The initial velocity of the projectile is 1,395 feet. At 33 feet, the ball passes through a spruce target 10¾ inches in thickness, and at 490 feet, a target about 5 inches in thickness. At 980 feet, it passes through a human arm in shattering the humerus and making a section of about three inches in the lumbar region of a second cadaver. The breech sight is graduated up to 1,640 feet, and the extreme range is a little over 3,000 feet.

FIG. 3.—THE PISTOL IN ITS CASE.

For the above particulars and the engravings we are indebted to L'Illustration.

FIG. 4.—THE PISTOL MOUNTED AS A CARBINE, WITH ITS CASE AS A BUTT-END.

The number and variety of barrels required in the different industries of the United States would astonish any one not familiar with this branch of manufacture, says The American Exporter. Barrels are now made from paper, from broad sheets or thick veneer of wood, and compete for the preference of the market with those made of wooden staves for the storage and shipment of dry materials. Paper barrels are made from a single sheet of straw-board curved to a cylindrical shape and held together with metal fasteners. Some paper barrels are made without a joint by a machine which, by centrifugal motion, throws the soft paper pulp against a mould. Steel barrels are used for the shipment of oil and gasoline, and a wood pulp barrel in which the pulp has been

chemically treated is often used for packing baking powder.

The importance of the cooper trade can best be demonstrated by the number of kegs used for beer alone. One local brewing company passes 12,000 kegs through its washroom daily, and this only represents a portion of the kegs used in the business. It is estimated by one of the employes that this company has more than 1,000,000 kegs of different sizes in constant use. Add to these figures the flour mills, nail mills, horseshoe mills, oil wells and refineries, sugar refineries, paint mills, varnish works, salt works, lime and cement works, glassware and lamp chimney factories, oyster, meat and pickle packers, and the multitude of other industries that use kegs and barrels for packing purposes, and the amount required daily is enormous.

THE EFFECTS OF HABITUAL TRAIN JOURNEYS ON THE BUSINESS MAN'S HEALTH.

THE British Medical Journal points out the seriousness of the injury inflicted on the users of the railways by the irregularity of the service. Common experience, it says, affords to every one of us ample familiarity with the ordinary trials of the railway traveler. The rush to the station to catch the train, which may perchance be punctual; the weary wait on draughty platforms or in stuffy waiting rooms; the dilatory journey—all these add seriously to the labor of the day even in the best of times; but when the weather is cold and damp they are still more injurious, in that they are largely responsible for those "colds," as they are called, those conditions of depressed vitality which are the starting points of most of the acute diseases from which men suffer, and from which the elderly and the feeble die. But outside and beyond these well-recognized evils, the unpunctuality of a railway service does a daily injury to those who depend upon it as a means of reaching their place of business by adding to that nervous strain which is the really hard part of a business life. An unpunctual railway, in fact, hits a business man in his most vulnerable spot. It is on the crisp activity of his mental processes that his livelihood depends, and the evil effect of the unpunctual morning train is not merely that it makes him arrive late at his office, but that it causes him to begin his work weary and annoyed. People talk about the "nervous strain" of railway traveling, which many folk, even medical men, attribute to "vibration" and high speed. Perhaps in long journeys in third-class carriages, where there is no rest for the head, vibration may have something to do with it; and as to high speed, if people persist in looking out of the windows, of course they suffer in consequence of the visual disturbances produced. But it is to be noted that experienced travelers always rush to quick trains, and especially to those that stop as seldom as possible. It is the worry of delay and the anxiety as to the time of arrival which is the great cause of nervous strain, that "tired feeling" with which most suburban-dwelling business men arrive in London. This, repeated day after day, undoubtedly has an evil and wearing effect on the nervous system. But it does harm in other ways, which are less obvious, but none the less effective, and this especially to people beyond middle life. The two great causes of high arterial tension in such people are worry and chill, and the one great remedy—practically the only remedy which can be got away from home—is alcohol. Thus it happens that when the city man arrives from his suburban home, chilled, worried, and late, with the stopcocks on all his blood-vessels so that his brain is starved and he cannot think, the craving for a "nip" of alcohol—the only available vasodilator—becomes overwhelming, and this morning drug is too often the beginning of the end. The more we consider this matter, says The Journal, the more convinced we are that the city man seeking for a suburban residence should study the punctuality of the train service rather than go by its advertised speed as described in those mendacious documents commonly spoken of as "time tables."

American Coal in Southern Germany.—No American coal has, so far as known, been shipped to Germany, but English coal is largely used here; shipments to the port of Hamburg alone for July amounting to 229,019 metric tons (of 2,204·6 pounds), says Simon W. Hanauer, Vice Consul-General at Frankfort. English steam coal is about to be introduced in Frankfort, negotiations for this purpose having been recently completed.

Up to date, the coal used in this section has come from the Ruhr mining district in the province of Rhenish Prussia.

There is no import duty on coal in Germany. The water freight rate for coal on whole ship cargoes from Rotterdam to Frankfort varies from 2½ to 3½ marks (59 to 83 cents) per metric ton (2,204·6 pounds) to 4 to 5 marks (95 cents to $1.19) in autumn. When water is low or the demand for vessels heavy, the rates are considerably higher. For the transfer of coal from ocean vessels to river barges at Rotterdam, the lowest rate is 35 pfennigs (about 8 cents) per ton, but it becomes higher when there is a special demand for labor.

A large Rhine steamship transportation company says, in answer to my inquiry on this subject:

"America could do a large business here, if able to deliver first class coal, suitable for boiler firing, like 'Westphalian blaze coal,' which to-day brings 12 marks ($2.86) per ton c. i. f. Rotterdam. To maintain this trade, when once fairly opened, the coal must continue to be of the same quality and must not come from different mines. The boats bringing it could be directed to our Rotterdam house (William Egan & Company); we would help the trade with all means in our power. We ourselves want a quantity of coal for our large fleet of steamers. We have contracted for our supplies until April next with Rhenish syndicates and English mines. We are well informed respecting the coal trade, and are ready to give any information, as our interest is to encourage the importation of coal."

This firm has 18 steamers, each of about 5,000 horse power and 9,000 registered tons, for the carrying trade on the Rhine. Other large firms are also engaged in transportation on this great waterway, which has its freight termini at Mannheim and this city, the Main River being navigable for heavy freight craft from its confluence with the Rhine up to Frankfort.

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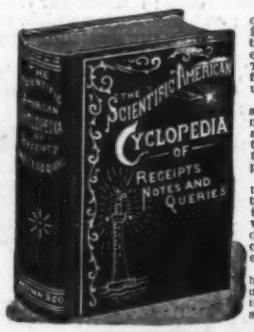

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